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USSR Report

ENERGY

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USSR REPORT

ENERGY

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INCREASE IN GAS CONDENSATE PRODUCTION URGED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 10 Oct 84 p 1

[TASS article, Moscow: "Gas Condensate Reserves"]

[Text] The general outlines for the promising development of the USSR gas industry are indicative of the enormous contribution gas producers can make to the country's economic potential from now till the year 2000. The All-Union Natural Gas Scientific Research Institute has worked out this development under the Energy Plan. The document gives considerable emphasis to the large-scale production of gas condensate, a valuable raw material for the production of automotive and aviation gasoline, diesel fuel and other chemical products. Institute Director A. Gritsenko replied as follows to a question asked by TASS Correspondent P. Ryabov on the developmental phases of what is essentially a new field:

"The 26th Congress of the CPSU has set a specific and very important task: increasing gas condensate production and effecting its more complete use. The staff of the institute will make every effort toward a successful solution of the problem. The first two condensate production wells were drilled at the Urengoy Field 2 years ago. With technology we developed, the wells were drilled through nearly 20 producing natural gas formations and reached the reservoirs of "white oil," as condensate is often called, at a depth of about 3,000 meters.

Condensate production and on-site refining technology was developed at the Urengoy Field. Based on the institute's blueprints for an experimental refinery, a facility designed to refine motor fuels from condensate was built. This unit was highly successful, greatly assisting Northerners to supply the equipment base with locally made gasoline and diesel fuel. A second refinery, modernized by the institute, with twice the capacity of the first plant, is now in operation at the Urengoy Field. With the cooperation of oilfield equipment specialists from the TsKB [Central Design Bureau], scientists have designed a unit which can refine 25 percent more condensate per year. These units are being put up in various areas around the country where promising reservoirs have been discovered.

We have made a second step of practical importance, having begun to develop a technique for conditioning this valuable raw material for shipment to centralized refining sites. A stabilizing facility is also being built at the Urengoy Field: undesirable impurities must be removed from the condensate before pipelining it. The institute's recommendations have also been implemented for the construction of a 700-km condensate pipeline to Surgut, where a gas refinery is being built. The equipment for it was also made with input from specialists from the All-Union Natural Gas Scientific Research Institute. Plans call for the production of several million metric tons of condensate in western Siberia by the end of the 5-year plan.

Finally, in the process of developing an experimental field production project in the Karachaganakskoye Field in the Caspian Basin, scientists began to tackle in earnest the problem of producing a greater percentage of condensate reserves. It was decided to apply technology being developed for the Novo-Troitsky reservoir in the Ukraine to the problem. At this field, optimum pressure is maintained by injecting residue gas into the formation, making it possible to produce 20 to 30 percent more condensate. Production at the Karachaganakskoye Field began with the drilling of two 5,000-meter production wells. Production will soon be pipelined to the Orenburg gas refinery. In time, a local refinery to be called the Ural'skiy Gas and Chemical Complex will be built near the field.

The overall development of the country's gas industry also calls for the extensive development of other gas condensate fields to increase condensate production under the plan: the Astrakhan, Yamburg and Zapolyarnyy [Transpolar] Fields.

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OIL AND GAS

DRY WELLS CAUSE SHORTFALL

[Editorial Report] Baku KOMMUNIST in Azeri on 2 September 1984 carries on page 2 a 1,200-word article by B. Hajyyev, general director of Azerneft, on achievements in the Azerbaijan petroleum industry. It is pointed out that the Muradkhanly Oil and Gas Administration fell 55,000 tons short of the plan in the first 7 months of the year. "Despite the operation of approximately 30 wells at Muradkhanlyneft, oil production has still not reached the level planned." It is added that "there is great instability in the beds, dry wells are numerous and the operating time of fuel-yielding wells is shortened due to water seepage. Eight of 10 wells drilled in 1982, 1983 and 1984 have been dry and 3 have been low in yield. As for the remainder, they began with high production but rapidly filled with water. Despite great efforts and engineering work, production is dropping. According to calculations of the Azerbaijan Petroleum Industry Scientific Research Institute, 600-650 thousand meters of exploratory wells must be drilled per year in order to stabilize and increase oil production. But our capability is only half of that."

CSO: 1831/408

SKS ROOF SUPPORT INTRODUCED

Kiev UGOL' UKRAINY in Russian No 9, Sep 84 p 3

[Text] The Shakhtinsk Coal Scientific-Research and Project-Design Institute has developed the SKS mechanized junction support for roof support and equipment transfer on the end sections of faces equipped with SO-75 and SN-75 plows.

The SKS support consists of two sections that move relative to one another longitudinally and transversely. The sections are connected by stiffening elements and have the necessary devices to accomodate the travel drive system, along with fasteners, an anchoring device, and hydraulic equipment. A distinguishing feature of the SKS support is the lack of connections between the table and the sections.

The support can be used in retreating ventilation drifts of plow faces which are mined by the retreat pillarless method. The support can also be used in trapezoidal or rectangular sections with a bottom width of not less than 4 meters and a height greater than 2.1 meters in seams which dip at angles of up to 12^{o}.

When used at the Yubileynaya Mine of Rostovugol' Association, the support provided reliable roof support at junctions, and reduced the lumber consumption.

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TELEVISION MONITORING DEVICE DOCUMENTATION PREPARED

Kiev UGOL' UKRAINY in Russian No 9, Sep 84 p 20

[Text] The All-Union Scientific-Research Institute for the Organization and Mechanization of Mine Construction has developed the working documentation for the support structures for the series-produced PTU-40-1 television unit. This unit has been proposed for use by Donetskshakhtoprokhodka Trust. It would be used by the hoist operator to visually monitor bucket unloading and for moving the buckets beneath the head frame.

The PTU is a single-camera, closed-circuit television system for monitoring production processes in explosion-hazardous enclosures and in explosion-hazardous areas outdoors.

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NEW CORNER CONVEYOR INTRODUCED

Kiev UGOL' UKRAINY in Russian No 9, Sep 84 p 25

[Text] Sibgiprogormash [Siberian State Institute of Mining Machinery Design] has developed a corner conveyor as a component of the KNK mechanized coal production system for steeply pitching seams. The conveyor consists of a face part and a passageway part, connected by corner sections. The face part contains an end (bypass) head and a chute. The passageway part contains a hinged section and an inclined section, a chute, and a drive.

The conveyor has a single chain located in the middle and forming a vertical circuit. The drive, located in the passageway, has a two-speed reducer with two electric motors. The scraping chain has speeds of 0.38 and 0.7 meters/second. The conveyors are used in systems that operate on faces from 10 to 80 meters long.

Series production of the conveyors has begun at Sibgiprogormash's Novosibirsk Test Plant.

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NEW PUMP MOTOR PROTECTION CIRCUIT DESCRIBED

Kiev UGOL' UKRAINY in Russian No 9, Sep 84. p 26

[Text] The Novovolynskaya Mine of Ukrzapadugol' Association is using a circuit for protecting the electric motors in pump stations for SNU-5 mechanized supports. The circuit is based on sensors to monitor the air flow rate of AZOT (AKV-2P) devices.

The sensor operates with a special air collection device, a diffuser made of sheet steel 2 to 3 mm thick. The diffuser is mounted between the two bolts fastening the housing of the VAF-62-4 electric motor, beneath the motor cover. The clearance between the end and the fan must be 4-5 mm. The diffuser tube is connected to the AKV-2P sensor by a rubber hose.

When the air supply is turned on and a pressure of 0.3-0.5 MPa is developed, the pressure sensor shunts the starter button contact. The emulsion tank level sensor is also connected to this shunting circuit. The starters of the VNR-32/20 pumps, connected through the booster pump starter contact, are energized through buttons. When each electric motor is operating, the fan supplies air through the diffuser and the hose to the AKV-2P sensor, which shunts the pump start-up button.

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DONBASS ROCK-BURST HAZARD CRITERIA REVIEWED

Kiev UGOL' UKRAINY in Russian No 9, Sep 84 pp 37-38

[Article by V. Ye. Zabigaylo, doctor of geological and mineralogical sciences, and V. V. Lykinov, candidate of geological and mineralogical sciences, Institute of Geotechnical Mechanics, USSR Academy of Sciences: "Influence of Regional Tectonic Processes on the Rock-Burst Hazard of Seams"]

[Text] According to the Instructions [1], rock-burst hazard predictions for seams in Donbass mines are made below certain depths. The boundary depths at which predictions begin are 400 meters when the volatile-matter content $V^{daf} \leq 35$ percent and the methane content $x \geq 6$ cubic meters/ton, and 150 meters when the logarithm of specific electrical resistance $\lg \rho = 3.3$ and the methane content $x = 20$ cubic meters/ton. No predictions are made for seams with $V^{daf} > 35$ percent or $\lg \rho < 3.3$, and no rock burst hazard is considered in the development of these seams. The absence of rock bursts in anthracite seams with $\lg \rho < 3.3$ is due to the fact that as their degree of metamorphosis increases, the methane content decreases and the strength increases.

The rock-burst hazard boundary determined by $V^{daf} \leq 35$ percent is debatable. Coal bursts and gas blowouts have recently been recorded in seams consisting of coals with $V^{daf} > 35$ percent. This has placed some doubt on the use of coal metamorphosis indicators to establish the critical depth below which rock-burst hazard predictions must be made before mining.

Analysis has shown that, all other technological effects on the seam being the same, the rock-burst hazard can increase, with equal probability, due to an increase in depth, a decrease in metamorphism, and an increase in methane content, or, these factors remaining constant, due to a decrease in the coal strength properties. In this case, the coal's degree of metamorphism, methane content, and strength properties have, in the most general form, a relatively close correlation [2]. Consequently, the boundary depth for seams consisting of coals with $V^{daf} \leq 35$ percent depends not only on the coal's methane content, but also on its strength properties.

The strength properties of different coals having the same degree of metamorphism are determined, to a great degree, by their exogenetic fracturing caused by the tectonic development processes in different regions of the Donbass. Therefore, these values (for coals having the same degree of metamorphism) vary from one geological-tectonic region to another. An analysis was made, based on these objective principles, of the rock bursts occuring in seams containing coals with $V^{daf} > 35$ percent. According to Makniya, such bursts occurred in mine seams in the Central Region (the Novaya Valyuga, Komsomolets, and imeni Artema mines), the Almaznaya-Maryevka Region (the imeni Menzhinskiy Mine), and the Donetsk-Makeyevka Region (the imeni Zasyad'ko Mine).

The Central Geological-Industrial Region is situated on the western portion of the Main Donbass Anticline, which has a sublatitudinal strike and steeply (50-75°) dipping slopes. The western contact of the Main Anticline has gently sloping seams, which are separated from the steep northern and western slopes by the Northern and Main overthrusts. The fault blocks, mainly of the overthrust type, on the southern slope dip to the south, while those on the northern slope dip to the north. The faults are also diagonal to the main strike of the rocks. In addition to overthrusts, the region is characterized by extensive faults, brachyfolds, and dome structures. The domes occur in the axis portion of the anticline and are accompanied by intense rock fracturing.

Tectonically, the Almaznaya-Maryevka Geological-Industrial Region has alternating large asymmetrical anticlinal and synclinal folds whose axes have a sublatitudinal strike. The southern slopes of the folds are gentle, while the northern slopes are steep. The main structures of the region are complicated by additional small-scale folding and overthrust faulting. The imeni Menzhinskiy Mine is located on the peak of the Pervomaysk Anticline, which has a latitudinal strike with an axis dipping to the west at an angle of 8-10°. The rock dip angles vary from 3-5° to 15-20°. The northern slope of the Pervomaysk Anticline merges into the southern slope of the large Golubovsko-Maryevka Syncline, which extends for 28 km in a sublatitudinal direction.

The Donetsk-Makeyevka Geological-Industrial Region occupies the southern slope of the Kalmius-Toretsk Basin. The central part of the region, where the imeni Zasyad'ko Mine is located, has sharply defined flexure folds which are perpendicular to the main Donbass folding. The general strike of the rocks is southwest; they dip to the northewest at an angle of 10-20°. There is extensive overthrust faulting, which can be divided into three groups: overthrusts with a sublatitudinal strike and northeasterly dipping fault blocks; overthrusts with a sublongitudinal strike and fault blocks dipping northwesterly at an angle of 20-45° and overthrusts with a sublongitudinal strike and fault blocks dipping northeasterly at an angle of 10-50°.

The basic fold and fault structures of the Donbass were formed during the Zaalian and Pfaltsian tectogenetic phases. They were repeatedly renewed and intensified after that. During the inversion period (the Zaalian

phase), the coal-bearing deposits of the Central Donbass Region were subjected to greater stresses than the other regions. The seven structural zones within the Donbass reflect the general level of paleostresses existing during the formation of the main folds and faults. The reduced paleostresses toward the basin's periphery are reflected in the smaller tectonic displacement of these zones, which lie almost symmetrical relative to the Main Anticline. The increased stresses in the coals caused structural changes which led to increased fracturing. Rock-burst-hazardous seams, as a rule, are highly layered, a condition which is closely related to exogenetic fracturing. In the sequence of coal metamorphosis, fracturing initially increases, reaching a maximum in the coking coal region, and then decreases (see Table 1). Fracturing varies from one region to another. The change in coal fracturing over the metamorphosis sequence is similar in the various regions.

Table 1.

Geological-Industrial Regions	Average Values of Exogenetic Fracturing of Coals (mm^{-1}) at V^{daf}				
	15-20%	20-25%	25-30%	30-35%	35-40%
Central	0.58/6	1.28/11	0.44/10	0.43/7	0.23/3
Donetsk-Makeyevka	-	1.12/4	0.41/14	0.35/3	-
Krasnoarmeysk	-	-	-	0.11/28	0.12/36

Note. The denominator contains the number of samples.

Consequently, the regional tectonic processes which formed the present structure of the basin have caused the coal fracturing to increase from the periphery toward the center of the basin. In other words, coals with $V^{daf} > 35$ percent will be more fractured in the Central Region, less fractured in the Donetsk-Makeyevka and Almaznaya-Maryevka regions and least of all fractured in the Krasnoarmeysk, Lisichansk, and Krasnodon regions. This explains the reduction in the number of rock-burst-hazardous seams with $V^{daf} > 35$ percent from the center of the basin toward the periphery.

Thus, the authors believe that it is proper to determine the boundary depths, below which seams must have a rock-burst hazard forecast before development, on $V^{daf} = 35$ percent and $x \geq 6$ cubic meters/ton for peripheral regions of the basin, which have minor tectonic dislocation. For the central region of the basin, the boundary depths should be clarified by taking into account the fact that V^{daf} and x do not consider the degree of seam weakening due to regional changes in exogenetic fracturing.

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NEW CONTACTLESS RAILROAD SWITCH CONTROL INTRODUCED

Kiev UGOL' UKRAINY in Russian No 9, Sep 84 p 40

[Text] The Leningradskaya Mine of Leningradslanets Association is using a contactless switch control system for K-10 and K-14 contact electric locomotives equipped with route addressing device (AZM). The system includes a signal input unit (BPS) and an AR-1 frame-type receiving antenna. The grounding contact of the BPS input relay is connected to the common input of the RKI-70 device.

A single frequency is used to control the switches. When the AZM handle is in the neutral position, the transmitting antenna does not operate; when the handle is switched to any position, a frequency is transmitted that is picked up by the receiving antenna and sent to the BPS-26, tripping its input relay. If the electric locomotive does not have an AZM (or the device is not working), the machine operator operates the switch by touching the contact sensor with a staff. In other words, it is an all-purpose circuit.

The introduction of the contactless switch control system has improved safety, eliminated failures, and increased 1.3-fold the throughput of the rail transport system.

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AUTOMATED ROOF-SUPPORT CONTROLS INTRODUCED

Kiev UGOL' UKRAINY in Russian No 9, Sep 84 p 41

[Text] Avtomatgormash has developed an automated control system for the M-87uma mechanized support. The system automatically controls the movement of support sections in the group. Other system features are: remote starting of section movement from adjacent sections; automatic cessation of movement when the stop button is pushed at any control panel; monitoring of the insulation and condition of the communication line wires; supply voltage monitoring and emergency signaling when a communication line is broken.

The system consists of a monitoring unit, control panels, modulator, pressure relay, and support section position sensors.

The automatic control system for the M-87uma support was tested at the imeni Zasyad'ko Mine of Donetskugol' Association and was recommended for commercial production.

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COAL

NEW PORTABLE TEST STANDS FOR ISU-RT DEVICES

Kiev UGOL' UKRAINY in Russian No 9, Sep 84 p 42

[Text] The ASUugleavtomatika Construction-Installation-Adjustment Administration in Donetsk is using three portable test stands for checking out ISU-RI information collecting devices. The stands were developed by the Special Design Technology Bureau of Soyuzugleavtomatika All-Union Production Association. It takes 10 hours to test and repair one ISU-RI device using the new stand, compared to the 16 hours that was previously required.

The test stand does not require a power supply, signal generator, or load rheostat. No oscilloscope is required when there is no need to monitor the signal shape and parameters, since lights on the stand indicate presence of signals and whether the proper code is generated. The stand can also do stand-alone tests of the replaceable modules in devices such as the ISU and US. When the modules are tested, they are mounted (with the joints on the front panel of the stand) so that measuring devices can be plugged into the control points and circuits. Stand-alone testing of the basic ISU-RI components and their replaceable modules using the test stand permits a quick determination of the problems and quick elimination of them.

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CURRICULUM COMBINE CHANGES ANNOUNCED

Kiev UGOL' UKRAINY in Russian No 9, Sep 84 p 45

[Article by N. I. Borychev, engineer, USSR Minugleprom [Ministry of the Coal Industry]: "New Statute on the Curriculum Combine, Its Branches, and the Study Point"]

[Text] The USSR State Committee on Problems of Labor and Wages, the USSR State Committee on Vocation and Technical Education (Gosprofobr) and the All-Union Central Council of Trade Unions have approved the Model Statute for the Curriculum Combine (Point) for the vocational training of workers. USSR Minugleprom, in agreement with the Central Committee of the Coal Industry Workers' Union, has approved the Statutes for the Curriculum Combine (Branch) and the Study Point for the vocational training of workers. Previous model statutes are no longer in force.

Three new sections have been added to the Statute. The section "Training Materials and Production Base and the Financing of Curriculum Combines" approved the areas for Curriculum Combines (UKK) and its branches, including classrooms, laboratories, offices, and workshops, depending on the planned number of production workers at the association (combine) and the number of students per year. The section "Organization of Training Work" details the procedure for training miners and improving their qualifications. Theoretical training of workers is done in groups of 10-30 people, while production training for servicing complicated equipment and for hazardous or especially difficult work is done in groups of not less than 12.

The section "Students of the Curriculum Combine" emphasizes that people are entered into the UKK by order of the UKK director according to the directions of the enterprises in accordance with the plan for vocational training approved by the enterprise or association. The age, gender and health of the UKK students must meet the labor law requirements for each profession.

People enrolled in the UKK must have deep theoretical knowledge and practical work experience. They must attend classes regularly and finish assignments specified by the plans and programs in the required time. They must be disciplined and organized, and observe the norms of socialist community. They must protect and strengthen socialist property.

The section "Management, Teachers and Production-Training Foremen of the Curriculum Combine" is very detailed. In particular, the UKK director ensures that the vocational training plans are fulfilled. The director also responsible for the organization and quality of training and the financial and management condition of the institution of learning.

Teachers and foremen are responsible for the quality of vocational training and for the knowledge and skill level of the students. Workers from associations (combines, trusts) and enterprises can be recruited as teachers in the UKK. They must know the basics of teaching to the extent specified in the program approved by USSR Gosprofobr.

Production associations, combines and trusts that have UKK under their jurisdiction must: 1) provide the teachers and other employees of the institutions of learning with the proper working conditions; 2) systematically provide them opportunities to improve their qualifications and 3) give constant attention to the proper use of their time and efforts.

The Statute on Branches of Production Association Curriculum Combines details the tasks, rights, and functions of the branch personnel. An association can create no more than three UKK branches.

The Statute on the Study Point (Group) of the Curriculum Combine was also approved. The basic tasks of the point are: 1) preliminary safety training for new workers and those switching professions; 2) preliminary training for special programs and 3) training, retraining and qualifications improvement for professions and specialities as specified in the model program, to last no more than six months. The Statute specifies the rights and functions of study point employees.

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ENERGY-GENERATING POTENTIAL OF MINOR RIVERS DISCUSSED

Tashkent PRAVDA VOSTOKA in Russian 22 Sep 84 p 3

[Article by T. Rashidov, member, Uzbek SSR Academy of Sciences, chairman of republican Science and Technical Department, M. Tashpulatov, first deputy minister for Uzbek SSR Power and Electrification, chairman, republican NTO governing board of the Power and Electrotechnical Industry, Kh. Dzhurayev, senior scientific associate of the Uzbek SSR Academy of Sciences Institute of Power Engineering and Automation, member, republican NTO council, "The Enormous Energy of the Little Rivers. Attention: Problem!"]

[Text] In the USSR power engineering program, which calls for leading production growth rates in electric power as compared to the growth rates for recovery of primary energetics resources, an important position has been assigned to the use of the potential energy reserves of small rivers as a new technical base: small-scale power engineering.

One of the regions where small-scale power engineering has been acknowledged as the most suitable is called Central Asia. Here, a trend toward increased water power capacity, as a result of the construction of powerful GES's [Hydroelectric Power Station(s)], has been confirmed. In Uzbekistan, wide experience has been accumulated in the construction and operation of the GES's which were constructed on the multipurpose hydrosystems.

The republic's "enormous" power engineering solves the combined problems of power supply, irrigation and transport, and no doubt reserves for itself a leading role in this area. But the latest achievements of scientific and technical progress show that the utilization of the energy from smaller rivers and irrigation canal overfalls, and the modernization of operating GES's and the rebuilding of the small GES's which have been removed from service can make a considerable contribution to the republic's power supply.

Efforts in this direction are already being carried out. The collective of the Central Asian Department of the Gidroproyekt Institute have prepared an evaluation of the water power potential of the small-scale GES's on the hydroeconomic systems and small- and medium-sized rivers of Central Asia. Facilities have been found and parameters have been established for standardized small-scale GES's which can feasibly be constructed. The evaluation of the economic effectiveness of erecting these top-priority GES's and recommendations for renovating existing GES's have been handed over.

Preliminary studies, which have been done by the Gidroproyekt Institute's Central Asia Department, demonstrate the feasibility of building small-scale GES's here in the republic, which would have a capacity of over 3.2 million kw, and which would utilize the potential resources of the Bolshoy Ferganskiy, Bolshoy Andizhenskiy and Severnyy Ferganskiy canals, and the Dargom-Taligulyanskiy waterway, which is in the Zarafshan River Basin. The need was pointed out to accelerate development of the planning documentation and construction of the highly-economical top-priority small-scale GES's on the Chirchik-Bozsuyskiy water-power route, the Akhangaranskiy reservoir, the Tupolang Rivers in Surkhandarya, and also to speed up renovation of the Kadyrinskiy GES, which will bring about an almost two-fold increase in its capacity.

Construction of small-scale GES's is economically profitable. They are constructed using standardized equipment and simplified plans. Quite in contrast to large-scale GES's, for which the principal share of the capital investments is earmarked for construction and equipment installation, 65 percent of expenditures for small-scale GES's is the cost of the equipment and its delivery to the installation site.

As a result, another of the most important ways of accelerating the profitability and construction of small-scale GES's stands out, and that is the reduction of expenditures for equipment. There are several directions here which the operation could take: delivery of standardized sets of equipment having a broad range of operating characteristics suitable for operation on rivers with varying water flows, and simplification of control equipment, the objective being to provide remote and automated control. And there is still the need to resolve the question regarding the most correct evaluation of the scope of operations involved in reconditioning those GES's which have been taken out of service, their updating and the volume of new construction in the different areas of an economic region. To accomplish this, UzSSR Minenergo, jointly with Gidroproyekt, needs to continue its survey of operating and out-of-service GES's.

The successes of small-scale power engineering will also depend on the development of standardized GES construction plans, and on the organization of series manufacture of standardized hydroturbine and electrical equipment in the Minenergomash [Ministry of Power Machine Building] plants. It would be advisable to entrust the construction of small-scale GES's with those organizations which construct dams and reservoirs, and installation of the equipment to organizations which install equipment there.

Small-scale power engineering has many tasks to resolve, but it also has many advantages. Construction of small-scale GES's within the republic is not linked to disturbances of the ecological balance. The conditions for their construction are similar, which in the first place solves, in many respects, the problem of standardizing equipment and planning operations, and in the second place, makes possible a considerable reduction in initial construction expenditures.

Small-scale GES's, which change natural conditions very little, create favorable conditions for the more complete utilization of the energy-producing potential of small streams of water. By the same token small-scale power engineering will lend support to the fulfillment of the Energy Program, and will insure a saving of fuel resources and will improve the energy supply of the national economy.

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BTSRN MULTICLONE CYCLONE TESTED ON KUZNETS COAL

Moscow ENERGETIK in Russian No 9, Sep 84 p 36

[Article by B. G. Yefremov and B. F. Kuznetsov, candidates of technical sciences, and A. V. Fomichev and A. I. Yelusov, engineers, all from the Kalinin Polytechnical Institute,"Industrial Text Results of BTsRN Multiclone Cyclone Separator Used For Ash Supression of Kuznets Coals"

[Text] At the present time, at a number of power stations, some of which are in the planning stage and some of which are under construction, multiclone BTsRN cyclones, which partially recirculate gases, are being used for ash separation during burning of Kuznets coals and other low-ash solid fuels. These cyclones were developed for boilers fueled by shredded peat. As results from the BTsRN tests, which were carried out at the Yaroslavskiy TETS-1 [Heat and Electric Power Station] showed, flue gases from peat ash were 94-95 percent cleansed.

At the Kalinin TETs-3, in connection with the conversion of their BKZ-210-140F fuel oil powered boiler over to burning Kuznets coal, a BTsRN-150-4X16X20 multiclone cyclone was installed, consisting of 1,280 cyclone elements, each having a diameter of 150 mm and a tangential gas intake, arranged into four sections (see Figure). The cyclone elements are set at an angle of 50° to the horizontal. The sections with the cyclone elements are enclosed in a single housing and form three ash chambers and two chambers for cleansed gas. To provide uniform distribution of gases to the cyclone elements and to preclude crossflow among them, 10-12 percent of the gases are drawn off to the recirculation circuit from the upper part of the ash chambers.

In order to determine the actual degree of flue gases cleansed from the ash the heat engineering department of the Kalinin Polytechnical Institute conducted two series of experiments (see Table) at varying boiler discharge levels. Internally-filtered zero-order [nulevoy] ash-removing tubes were used to measure ash content.

After four months of operation, the multiclone cyclone separator underwent the first series of tests at operational levels similar to those rated for the device. The degree of purity of the gases turned out to be considerably lower than projected , and amounted to 68-64 percent, the values on the technical and operating data certificate being 91.9 percent. Pressure loss from the

ash collector exceeded the normal values by 620-650 Newtons/m^2. Results of a microscopic analysis if the range of particle dimensions for the ash showed that, on the BTsRN intake, the weighted average radius of the particles on the surface was 9-10 micromillimeters (as for 13-15 micromillimeters for shredded peat particles).

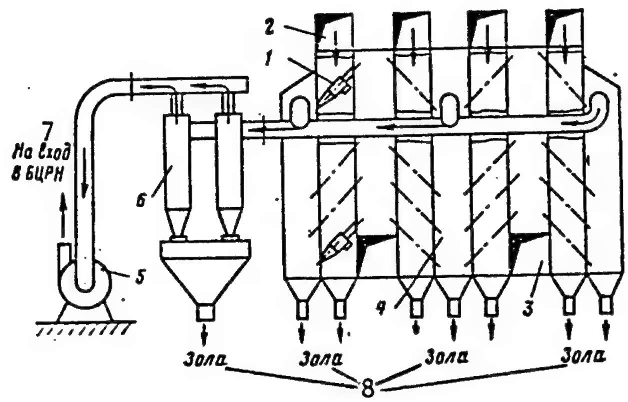

Figure:
Gas Recirculating BTsRN Multiclone Cyclone Separator:
1--separating element; 2--chambers for gases feeding into purifying process, 3--chamber for cleansed gases, 4--ash chamber, 5--recirculating exhaust fan, 6--recirculating cyclone group, 7--to BTsRN intake, 8--ash (discharge).

1 Показатели	2 1-я серия опытов		3 2-я серия опытов		4 Паспортные данные
	Номера опытов 5				
	1—4	5—7	8—10	11—12	
6 Паропроизводительность, т/ч	192	193	189	155	210
7 Объем очищаемых газов при нормальных условиях, тыс. м³/ч	213.8	229.9	227.5	196.1	223.2
8 Степень рециркуляции, %	11.3	10.6	10.5	12.5	10—12
9 Запыленность газов перед БЦРН, г/м³	11.68	10.81	5.55	7.59	12.4
10 Запыленность газов за БЦРН, г/м³	3.75	3.89	1.92	1.93	1.0
11 Степень очистки газов, %	68	64	66	75	91.9
12 Гидравлическое сопротивление БЦРН, Н/м²	1500	1530	1520	1400	880

Table.
Key: 1--Indicators, 2--First series of experiments, 3--Second series of experiments, 4--Operating certificate data, 5--Experiment numbers, 6--Boiler capacity tons/hour, 7--Volume of cleansed gases under normal conditions, in thousands of cubic meters per hour, 8--Degree of recirculation, percent, 9--Dust content of gases prior to BTsRN treatment, grams/m^3, 10--Dust content of gases after BTsRN treatment, grams/m^3, 11--Degree of purity of gases, percent, 12--BTsRN pressure (friction) loss, Newtons/m^2.

The multiclone cyclone was examined to find out the reasons for its low effectiveness. Inspection of the cyclone elements showed that most of the ash ex-

haust outlets were clogged with ash. In addition, the intake and exhaust nozzles of a number of the elements turned out to be clogged with ash. Thus, 16 percent of the cyclone elements were completely plugged to the passage of gases, and the gases passed through 28 percent of the elements without being cleansed.

After the inspection of the interior of the multiclone cyclone separator, the cyclone elements were thoroughly cleaned with cold water. The tangential element intake was especially difficult to clean. From below, through the ash chamber exhaust ports, it was impossible to reach the cyclone element intake because of the small diameter of the exhaust port and the limited space between the exhaust nozzle and the cyclone element housing. Gas is supplied to the cyclone elements, which are placed one above the other, from below, and for this reason a variety of equipment must be used to clean the elements, which complicates operation of the multiclone cyclone even more.

In discussing the reasons for the low effectiveness of the BTsRN, it was suggested that the cyclone elements became clogged while the boiler was being started up, the ash trap was insufficiently heated up, or its operation routine was being disturbed in other ways.

As a consequence, the ash trap was meticulously cleaned of ash prior to the second series of experiments, and it was put into operation with all required operating instructions being observed. The second series of experiments was conducted after the ash trap had been operated for ten days. In this series of experiments the boiler was run with an intense fuel oil flame, which reduced the ash content of the flue gases on their way into the BTsRN. The last two experiments were conducted with lowered steam production from the boiler, but with a somewhat greater degree of gas being recirculated from the ash trap. However the efficiency of the gas-cleansing in comparison with the first series of experiments showed little improvement, amounting to 66-75 percent. Pressure (friction) loss remained practically unchanged.

The low operational efficiency of the BTsRN can be explained by the wearing out of the elements by the highly-dispersed coal ash. This fault, it appears, is an organic fault of BTsRN construction which has to do with the cyclone elements being positioned at a slant, at which the angle to the horizon of the bottom of the cone-shaped element turns out to be nearer the angle at which the ash is naturally drawn off. Another factor which fosters the clogging up of the BTsRN with ash. is the small diameter of the ash exhaust vents of the cyclone elements. Thus, the multiclone BTsRN cyclone separator, which operates reliably and efficiently behind boilers which burn shredded peat, is unsuitable for cleaning flue gases of the finer coal ash.

Multiclone cyclones with vertically positioned cyclone elements having large diameter ash exhaust vents should be used for coal-dust boilers.

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ELECTRIC INSULATOR INDUSTRY OFFICIALS REPRIMANDED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 19 Sep 84 p 2

[Unattributed article,"There Are Orders, But No Insulators", under the rubric, "The Paper Has Appeared. What Has Been Done?"]

[Text] In Ye. Panov's reply under the above title, published 17 June, it was said that it has been 13 years already and in spite of the repeated decisions, Minelektrotekhprom [Ministry of the Electrical Equipment Industry] is unable to organize production of industrial fuses.

Development of insulators, which was entrusted to the "Soyuzelektroizolyator" VPO and specifically to the Gzhelskiy Production Association, became an obstacle.

N. Pronin, deputy minister of the electrical equipment industry, reported to the editorial board that the reply has been considered. Putting the new series of fuses and their ceramic components into production has dragged on because of the irresponsible attitude regarding execution of the joint order from Minelektrotekhprom and Minstankoprom [Ministry of the Machine Tool and Tool Building Industry] on the part of individual Soyuzelektroizolyator VPO workers, the equipment administration, and also from the Gzhelskiy Elektroizolyator Production Association, VNIIEK [All-Union Scientific and Research and Planning and Technological Electroceramic Institute], VNIIelektroapparat [All-Union Scientific and Research Electric Equipment Institute] and the Kashinsky Electrical Equipment Plant. The question of the disciplinary responsibility of these workers has been taken under consideration at a meeting of the board.

It has been announced that N. Gorelov, chief engineer of the Soyuzelektroizolyator VPO, Yu. Kiryushin, deputy administrator of the Soyuzpreobrazovatel' VPO, and also V. Makarov, chief engineer of the Gzhelskiy Elektroizolyator Production Association and S. Tsarev, director of the Kashinskiy Electric Equipment Plant, have been reprimanded. And the very same punishment measures have been meted out to Deputy VNIIEK Director N. Bulakh and Gzhelskiy Production Association Chief Engineer A. Yablokiv, by order of the Soyuzelektroizolyator VPO.

By a decision of the Ministry Party Committee, Deputy Chief Engineer of the Soyuzelektroizolyator VPO Yu. Romanov, Chief of the Technical Administration Department V. Kozlov, and Deputy Department Chief P. Dorozhkin were given a party reprimand.

The plan and schedule for preparation and putting standardized fuses for machine tool manufacturing into production, with the work to be completed in 1985, has been approved. The deadlines have been approved by ENIMS [Order of Labor Red Banner Experimental Scientific and Research Machine Tool Institute].

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URENGOY PIPELINE CONSTRUCTION ACHIEVEMENTS, NEEDS DISCUSSED

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 9, Sep 84 pp 3-5

[Unattributed article, "The Potential Of Science Is In The Service Of The Industry"]

[Text] Putting the decisions of the 26th CPSU Congress and successive CPSU Central Committee Plenums into practice, Minneftegazstroy [Ministry of Construction of Petroleum and Gas Industry Enterprises] is successfully implementing major programs in the construction of industrial projects, main pipeline systems, gas refineries, and residential, social and cultural-domestic construction.

During 3.5 years of the 11th Five-Year Plan period, a program of contract work amounting to 20 billion rubles has been developed.

Forty-two thousand km of main pipeline have been put into operation, including 13.5 thousand km of 1,420-mm pipeline, which amounts to 3,500 km more than in the entire 10th Five-Year Plan. The Urengoy-Gryazovets-Moscow, Urengoy-Petrovsk and Urengoy-Novopskov pipelines were built and put on line 2-3 months earlier than the established deadline. At the same time, all these pipelines were started up at their projected productivity level the same year the linear pipeline portion was finished.

The Urengoy-Uzhgorod and the Urengoy-Tsentr-1 pipelines were made operable six months ahead of schedule. Construction of the sixth and final gas pipeline, the Urengoy-Tsentr II, from Western Siberia to the European part of the country, will be completed for the most part prior to the end of 1984, and thus, completion of one system of those slated for the 11th Five-Year Plan.

Construction has been completed on 155 compressor, and 66 pumping stations. Living quarters, in the amount of 6.1 million m^2 have been turned over for use.

During three years of the five-year plan period, labor productivity has increased by 21 percent.

These successes have been determined in large part by the assimilation of scientific and technical achievements and advanced experience into production on a widespread basis.

There are, today, within the Minneftegazstroy system, five scientific and research institutes: VNIIST [All-Union Scientific and Research Institute for Main Pipeline Construction], NIPIorgneftegazstroy [Scientific, Research and Planning Institute and Organizational Petroleum and Gas Construction Association], SibNIPIgazstroy [Siberian Scientific, Research and Planning Institute of Gas Construction], VNIIPIgidrotruboprovod [All-Union Scientific Research and Planning Institute of Hydraulic Pipelines] and VNIIPItransprogress [expansion unknown], three planning and design organizations: the Gazstroymashina [Gas Machine Construction] SKB [special design office], the Proyektneftegazspetsmontazh [Oil and Gas Planning and Special Installation Association] SPKB [Special Planning and Design Office] and the EKB [Experimental Design Office] for ferro concrete, GIVTs [main information and computing center] and six IVTs's [information and computing center(s)] of the main administrations and associations, 10 Orgtekhstroy's [technical construction organization], the Neftegazstroytrud NOT [scientific organization of labor] Center and 14 standardizing and research stations. The volume of scientific and research, experimental and design, and planning and investigation operations in 1984 amounts to 31.4 million rubles.

The system-programming method of planning scientific and technical progress is being used in the industry. Scientific and research institutes, design offices, organizations and enterprises are carrying out research and developments in 23 All-Union scientific and technical programs and 20 industrial scientific and production programs. Outlays for realization of these programs are more than 60 percent of the overall expenditures for scientific and research operations. This is evidence of the concentration of efforts toward solving the industry's main tasks.

During the 3.5 years of the 11th Five-Year Plan 86 plans for machines and mechanism were developed, 73 experimental models were manufactured and 41 machines were put into series production. A combination of domestic equipment used for 1,420-mm diameter pipeline construction, and which mechanizes the basic operations on lenear section construction by 99.7 percent has been developed and is in production. Power availability per man involved in construction increased to 34.4 kilowatts.

Usin developments from the institutes and design offices, a technical re-equipment of the industry is under way, including a conversion from construction-installation operations to highly mechanized, power-saturated production, which is insuring the fulfillment and overfulfillment of plans for increased in labor productivity.

Production has been organized in the machine-building enterprises of the ministries, and over 40 new types of welding equipment, instruments and materials have been introduced on the industry's construction sites. Fundamentally new "Sever" units, for contact-welding of large-diameter pipe, the "Styk", for automated welding of non-rotating joints with flux-cored wire, highly mechan-

ized BTS [expansion unknown] facilites for bilateral automated flux welding, mobile and self-propelled multistation welding units, and new quality control equipment for welded joints have been developed and are successfully being operated. This efficient equipment is showing up on the rights-of-way. Every year, through the use of electric arc welding, 2,500 km of industrial grade pipeline are constructed, for the last few years over 750 km of pipeline have been constructed by using "Styk" units, 400 km of mains have been welded with "Sever" units, and over 1,500 km of pipe have been welded at BTS facilities.

In 1983, 69 products, including excavators, welding units, insulating films, expanded clay gravel and spiral-seam pipes were produced with the state mark by industrial enterprises. In all, 107 production items were certified, the production of which amounted to R307 million.

Within the industry a special system has been set up to effectively plan and administer construction of the most important pipeline mains, which system is in full accord with modern organizational modes of line construction. This system provides control over the progress of these projects at all stages of construction: organizational, preparatory, basic and completion stages, and encompasses all levels of management--from the primary production collectives to the central ministry staff. The tasks of planning, prediction, accounting, checking and analysis are all realized within the scope of this system.

The industry has large-capacity computers available, and this capacity will be further increased in 1984. The adoption of mini- and microprocessing equipment into the management of construction operations shows promise. A network of territorial consumer's stations has been set up, which serves as the basis for the tasks of control over construction of especially important projects.

A method of manufacturing and organizing construction of large pipelines using integrated production lines has been developed. The realization of these developments has enabled construction of our transcontinental gas pipelines to be done ahead of the established deadlines.

The average productivity for flow-line method pipeline construction has increased significantly.

In order to stabilize the pipelines and to secure them at projected levels during construction in flooded and swampy locales, the industry has used over 1.5 million cubic meters of added ferroconcrete ballasting [prigruzov] and up to 100 thousand sets of anchoring devices. However, use of these ballasting devices requires enormous transport expenditures, considerable outlays of metal and cement, and their installation is extremely labor-intensive.

Lately, more efficient methods of ballasting have been found. A new ballasting procedure has passed its trials and is recommended for production. This new method calls for ballasting pipelines with soil and uses synthetic materials, permitting a cost reduction for ballasting and a reduction in freight haulage. Efforts are being carried out using particularly heavy-duty structures for loads set on a foundation of slags from metallurgical production. Using the indicated structures during ballasting operations on the pipelines

will permit a two-fold reduction in labor expenditures, a 40 percent reduction in concrete demand, and a 75 percent in the demand for cement, will reduce freight haulage by 40 percent, and will realize an economic effect of up to three million rubles per 100 km of pipeline. An experimental set of ring-shaped slagged weights for underwater pipelines has been fabricated.

In the sector of developing and implementing electrolytic protection, a basic trend is the industrialization of EKhZ [electrolytic protection] equipment construction and the increased output power of the cathode stations. A number of new cathode stations have been developed: the SKZV-UKhL I cathode station for cold and temperate climates, which is fed from a high-voltage network, a standardized block-set cathode protection station [UBKSK] which is fed from a 220-volt network, the pulsed-current cathode protection installation etc. Use of the pulsed-current cathode protection installation has reduced electric power expenditures 9-fold.

To protect main pipelines from underground corrosion, we have developed the PMP 20X10 extended magnesium protectors, which are 20 mm in diameter, and which are laid in the trench during construction. Based on the results of trials on the Kiev-Western Ukrainian Regions gas pipeline over 3.5 years, these extended cathodic protectors have been recommended for series production.

Extended cathodic protectors designed to protect pipelines from corrosion during construction, and in areas lacking an electric power supply, are being developed by a number of institutes, and look promising.

In accordance with the ministry's special program on quality and reliability, a broad set of measures is being implemented in the realm of the technology of manufacturing methods, raising the level of mechanization and automation used in carrying out technological processes, setting up an integrated system of quality control, of developing new means of metrological control, of raising workers' qualifications, as well as those of engineering and technical workers, and of improving the system of material and moral stimuli.

As a result of this program having been realized in the 10th Five-Year Plan period, the number of breakdowns on operating gas pipelines for reasons connected with flaws in construction and installation operations were reduced 1.5-fold in comparison with the 9th Five-Year Plan period. Of the overall number of welded joints which were checked, the number rejected did not exceed five percent, which is in accordance with the number of welded joints rejected during pipeline construction abroad.

The number of breakdowns continues to be reduced during the 11th Five-Year Plan. If the number of breakdowns per 1000 km amounted to 0.54 in 1981, then it was 0.35 in 1982, and 0.31 in 1983. For a comparison, we note that job breakdowns on pipelines in the United States are characterized by a breakdown frequency of 0.68.

Preparations have been carried out for the development of 10 MPa pipelines: an experimental section has been constructed and put into operation, and construction has begun on a 300-km section using multilayer pipe for this pressure.

The complete-unit method for overland construction of pipelines has undergone continued development. In 1983, R800 million worth of construction and installation operations were completed using this method.

A manufacturing method and a method of organizing construction have been developed for building compressor stations, to be equipped with 16- and 25-thousand kw units, by the complete-unit method. In connection with this, and depending on the type of gas re-pumping equipment used, the labor intensiveness was reduced by 12-40 percent. For the Yamburg gas condensate field, fundamentally new technical solutions for erecting industrial installations have been developed, using sectionalized pontoons, the mass of which is over 300 tons, and which will be delivered by water or overland, using air-cushioned hauling equipment.

The industry's enormous creative potential is also reflected in the widespread growth of the rationalizers' and inventors' movement. In 1983, 19 thousand inventors and rationalizers submitted 19.7 thousand proposals. Of these, 17.5 thousand proposals and 351 inventions were used in production. Thanks to the adoption of these ideas and inventions, over 5 thousand tons of metal, 5.5 thousand tons of fuel, 6.6 million kw/hours of electric power and 13 thousand tons of raw materials and goods have been saved. The overall economic result amounted to R52 million. In 1983, 157 applications for proposed inventions were submitted by NII [Scientific and Research Institutes] and design office workers, and 102 affirmative decisions were made regarding the issuance of authors' certificates. Forty-eight of these inventions have been issued patents abroad. Six licenses have been sold in the United States, Japan and the FRG. Over 90 percent of the developments from the scientific and research institutes and design offices find practical application, are adopted into construction production and are included in standardizing documents and planning decisions. The result of using developments from the scientific organizations amounts to five rubles for each ruble expended.

The potential for the industry's science has increased considerably, thanks to the widespread drawing in to scientific problems of the institutes of the USSR and the UkSSR Academies of Science and over 30 of the country's VUZ's, and to the utilization of the results of scientific and technical cooperation with countries abroad.

Automated units for welding pipelines and pipecomponents, electroslag casting, a process for replacing worn-out machine parts through the use of plasma spraying and extremely high-strength hard-facing have all been developed and introduced into the industry by the Institute of Arc Welding imeni Ye. O. Paton. The MINKh i GP [Moscow Order of Labor Red Banner Institute of the Petrochemical and Gas Industry imeni Academician I. M. Gubkin] is participating actively in the development of equipment for securing pipelines at plan levels, a hoistless pipeline laying method and a technique for drilling underwater pipeline crossings. The Ufa Petroleum Institute has proposed the intro-

duction of a process of stabilizing soils by reclamation. The Moscow Order of Lenin and Order of Labor Red Banner Higher Technical Institution imeni N. E. Bauman is developing fundamentally new automated ultrasonic devices with high resolution capability for checking welded joints. The Institute of Mechanics, conjointly with the USSR Academy of Sciences, is in the process of developing a technical diagnostics system for pipelines utilizing the acoustic emissions method. A high-frequency procedure for welding on automated pipe stands has been realized by VNIImetmash [All-Union Scientific and Research Institute of Metals and Machinery]. VNIIST [All-Union Scientific and Research Institute for Main Pipeline Construction], together with institutes of the UkSSR Academy of Sciences and Minkhimmash [Ministry of Chemical and Petroleum Machine Building], have developed and tested a compounding, and have tested a manufacturing method for heat-shrinking [termousazhivayushchayasya] tape. Equipment has been assembled and set up at the Novokuybyshev plant for insulating materials. Commercial production of adhesive tape will be initiated this year. A special tape, applied when cold, has been developed by VNIIST and the Petrochemical Institute of the UkSSR Academy of Sciences.

Moreover, a number of important problems are taking a protracted length of time to be resolved. Individual developments are not being widely or quickly adopted within the industry. There are still great unused reserves in the activity of the institutes and design offices. The method suggested by VNIIST to insulate pipe at the Beloyarskiy facility has turned out to be unfinished, and fundamental changes are now being made in it. In the VNIIST needle-cutter cleaning [iglofrezernaya ochistka] laboratory, in a period of 20 years they have been able to achieve only the re-equipping of some of their field cleaning machines by replacing the regular brushes on the needle-cutters.

In order to expand the raw material base and raise the quality of factory-furnished insulation, we should, by all means speed up the joint operations between VNIIST and the USSR Academy of Sciences' Institute of Synthetic Polymers, to create compounds, including powders using polyethylene sealed with vulcanized rubber. The introduction of vulcanized rubber permits, according to a preliminary evaluation, up to a 30 percent reduction in polymer outlays. The creation of compounds which increase the adhesion of the covering to the surface of the pipe must head the list in these operations.

A persistent sore point remains the protection of the internal surface of storage tanks from corrosion. The epoxy films used for this purpose are insufficiently long-lasting, are labor-intensive, and they can be worked with only during the summer months when the humidity is 60 percent or less, and at temperatures of no less than 10° C, all of which limits their use in the conditions of Western Siberia.

Instead of using epoxy films, the Siborggazstroy Firm, along with VNIIST, has suggested using a method of protecting petroleum storage tanks with PRM-20 magnesium protectants. The directive "Instructions on Cathodic Protection of the Interior Surfaces of Petroleum Storage Tanks From Corrosion", has been developed and approved. This is the fundamental document on the protection of commodity, raw materials and industrial petroleum storage tanks, from corros-

ion. However, widespread adoption of cathodic protection devices is being held back because of the necessity of large expenditures of scarce materials. The search for new and effective methods of protection is not being carried out with any sense of urgency.

Tests of a system for cathodic protection against corrosion in storage tank interiors, which were carried out at the Fedorovskiy field, have produced positive results. In order for this system to be adopted, commercial production of ferro-silicone anodes will have to be expanded.

The tasks of this industry's science are constantly being complicated by the gas and petroleum industry's raw material base being moved into isolated regions having complex natural and climatic conditions. At the present time, organizations of the ministry have begun development of the Yamburg gas-condensate field and the Caspian Region Basin, and the Yamal Peninsula is being prepared for start-up of operations.

Research and development connected with increasing the level of industrialization of construction, automation of welding operations, with the growth of the power available for labor in construction, the development of equipment and methods for year-round construction of main pipelines, the introduction of uninterrupted and specialized modes of transport and hydrotransport systems for coal and ore concentrates, and the technical re-equipping of machinery-building and repair enterprises, are becoming all the more urgent.

The technical level attained in welding operations is found to be unsatisfactory. The portion of welding and checking of welded joints still done by hand is great. There still remains a great amount of work to be done on increasing the quality of equipment and materials manufacture and on reducing the time spent on developing, manufacturing and testing of experimental models of new welding equipment. The need to organize the services of a chief welder at the construction industry enterprises and at the industry's machine building plants has become pressing. There is still an area of work which is untouched here. There is a need to create new technological processes for welding, and to change primary and auxiliary welding equipment over to robot-welding units, which are to be controlled by microprocessors with automated weld quality control follow-up, with parameter correction included in the production process.

Experience shows us that increasing the use of pipe having plant-furnished insulation is an efficient solution toward improving corrosion protection for pipelines, and increasing their reliability and the industrialization of pipeline insulating and laying operations. The construction of pipelines using pre-insulated pipe allows main pipelines to be laid considerably faster, saves labor resources, and reduces the number of machines and mechanisms used.

However, adhesive polymer tapes will remain a basic form of protective covering for pipelines for the next few years. A plant is slated to be built in Novokuybyshev which will provide the main pipeline construction industry with insulating materials, and starting in 1986, will initiate production of two-ply polyethylene tape, complete with adhesive wrapper and primer, at a volume of 60 thousand tons per year.

A serious problem in connection with the development of operations in Western Kazakhstan and at the Astrakhan field is the need for development of insulating materials for hot sections of the pipelines, which operate at temperatures above 80° C. We need to intensify the search for new solutions and to stimulate work with USSR Academy of Sciences and Minkhimmash institutes on the development of equipment and the production of heat-resistant, polyethylene-based tapes.

It should be noted that up to the present time, the technical level of complete-unit construction has frequently been evaluated in comparison with traditional construction. This no longer corresponds to either the scope of operations or the industrial complex's level of development. Right now, a considerable portion of construction and installation operations [up to 60 percent of the cost of above-ground portions of projects] have been transferred to assembly and procurement enterprises, and unitized arrangements are, in principle, little different from such commercial items as railroad cars, vehicle bodies, ship hulls etc. That is why it would be fairer to compare the technical level to that of the advanced achievements in industry and construction. This approach makes a more objective evaluation of the successes possible, and makes it easier to see existing reserves more clearly. At the present time, the proportionate outlay of metal per cubic meter of box volume amounts to 40-50 kg. An outlay of 20 kg/m^3 corresponds to the state of the art technical level.

The extent at which the available volume of boxes is being used does not exceed 50-70 percent. Here there exist several ways: a changeover to lower boxes, implementation of modern methods of arrangement solutions, the introduction of intersectorial sequential equipment development for "technological effectiveness" during complete-unit construction.

In order to achieve an advanced technical level in the plant technology of manufacturing block-boxes, we need to adopt limiting standards for delivered equipment and components, and to organize aggregate combinations of the components and junctions, and to develop a flexible method of manufacturing, based on universal equipment assemblies.

The time has come to set up a unified system of construction designs for block construction instead of uncoordinated designs from the EKB [experimental design office] for ferroconcrete, and from SibNIPIgazstroy [Siberian Gas Industry Construction Scientific and Research and Planning Institute].

To accomplish this objective, a sufficiently harmonious system for developing box designs, for planning the technology for their production and for the organization of their manufacture at assembly and procurement enterprises, has been organized. SibNIPIgazstroy's main institute has a lot of work to do to unify block designs and raise their quality, and a widespread drawing-in of the potential from scientific and design organizations to this critical work is needed.

The main trends for technical progress in industrializing zero-cycle operations have to be a changeover to pile foundations beneath pump and compressor units, the use of ferroconcrete slabs for compressor shop subfloors, and erection of distribution lines on scaffolding.

The search for progressive technical decisions in the area of above-ground construction, and especially in the area of residential construction, must be intensified.

We need to study the possibility of using material-economizing designs in the industry,which have been developed by a number of institutes from other departments, in particular, those which provide for the use of nonmetallic fibers which are stirred into and hardened with the concrete, instead of alloy-treated reinforcing-bar steel. There should be wider adoption of concrete-delivery trucks and mobile concrete mixers, and automated equipment for making concrete mixes. And there is the problem of improving the design for concrete forms, thereby considerably increasing their turnover rate.

The successful solution of these problems will permit a great increase in labor productivity on above-ground construction and will overcome its complicated condition of being behind line-construction operations.

Full utilization of the potential possibilities of industrial science will speed up the scientific and technical progress of oil and gas construction, and will, as a consequence, increase its effectiveness.

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WESTERN SIBERIAN YEAR-ROUND PIPELINE CONSTRUCTION ATTEMPT

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 9, Sep 84 pp 6-8

[Article by S. P. Vel'chev, of Glavsibtruboprovodstroy of Tyumen, and V. P. Mentyukov, of VNIIST of Moscow, "Large-Scale Experiment in Year-Round Construction in Western Siberia", under the rubric, "Decisions of the 26th CPSU Congress in Practice"]

[Text] "Through implementation of the basic directions for economic and social development of the USSR for the years 1981-1985, and for the period up to 1990", which have been approved by the 26th CPSU Congress, are the development and adoption of methods and processes by which pipeline construction in complex conditions can be carried out on a year-round basis, envisaged. The importance and urgency of finding a solution to the above problem have been determined by the considerable volumes of oil and gas main pipeline construction in Western Siberian regions, and which are characterized by the extreme swampiness and the presence of the permanently frozen ground.

Since, at present, there is an absence of the necessary unitized swampland-traversing equipment in world practice, necessary to lay pipelines in these conditions, and since development of such equipment requires a long time, extending beyond the time available in the present five-year plan period, the tasks connected with organizing and adopting year-round construction must be solved in two stages. The first stage is a conversion, during the 11th Five-Year Plan period, to year-round construction by virtue of the realization of already-developed, and the very best new, technical and technological decisions regarding the entire complex of operations, and based on the use of modern means of mechanization, including existing swamp-traversing transport vehicles and construction equipment. At the same time, while experiments are being conducted, we will be checking, according to their degree of development, all-terrain vehicles, units and combinations thereof, which will have been developed by the industry's institutes and organizations and other departments, and which will determine an essentially different approach to methods of handling individual types of operations as well as the entire pipeline constructing process. In the second stage, promising methods of laying pipelines in swamps and marshy sections will be checked out and realized, using special self-propelled all-purpose unitized all-terrain units.

To accomplish the scheduled completion of the engineering and preparatory measures and the immediate commercial and experimental work on facilities which were under construction, Glavsibtruboprovodstroy [Main Administration for Siberian Pipeline Construction] and VNIIST [All-Union Scientific and Research Institute for Construction of Main Pipelines], in 1983, developed their "Program and Procedure for Conducting a Large-Scale Experiment in Implementing Year-Round Pipeling Construction in Swamps and Flooded Locales," which was approved by the Minneftegazstroy [Ministry of Construction of Petroleum and Gas Industry Enterprises] management.

In accordance with this program, in the main administration, the experimental work is accomplished through the use of two production lines, one in the Severtruboprovodstroy [Northern Pipeline Construction] Trust (SU-60 [Construction Administration], Production Line S-5), and the Kazymtruboprovodstroy [Kazym Pipeline Construction] Trust (SU-42, Production Line s-9). The overall length of the sections constructed by the above production lines was about 300 km.

The objective of this large-scale experiment was to determine the most favorable technical and technological solutions for year-round pipeline construction, considering the natural and climatic and hydrologic factors, and also to determine the most productive season for work on the route during which the effectiveness and the quality of completion of the entire complex of operations on the linear section of the project would be improved. This objective has been realized using an analysis and correlation of the work done by the production lines with a record of the conditions at specific sections along the right-of-way, of the technological diagrams which were used, the equipping with material and labor resources, of the daily rates which were achieved for individual types of work and for combined production lines overall, of the adoption of new technological methods and means of mechanization and equipment, of brigade make-up etc. The "Procedural and Organizational Recommendations for Year-Round Pipeline Construction in Swamps and Flooded Locales" (VNIIST, R491-83) was used as the basis for perfecting various strategies for pipeline laying which provide for modern technical and technological solutions using the most productive, including the most recently produced, swamp-traversing machines and mechanisms. This will permit, as a result of the conducting of the experiment, the setting up of valid departmental construction norms in this particular important direction.

A combination of engineering and preparatory measures is being implemented, which will insure year-round construction on the selected sections of the Urengoy-Tsentr gas pipeline route (the Severtruboprovodstroy Trust is working on the stretch from the 218th to the 293rd km, and the Kazymtruboprovodstroy Trust is at work on the stretch between the 567th and 653rd km), and these measures are also being taken on the trial 300-km section, on which multilayer pipe is being used. These engineering and preparatory measures have provided for the establishment of needed surpluses, to be transported before April 1984, out to sections which are to be built during the summer, of pipe, pipe sections and curved branch pipes, to the trusts' respective sections, in 40- and 35-km lots, of overweights in sets of three thousand and 2.5 thousand respectively, two thousand and 2.5 thousand tons of fuels and also

lubricants, and, finally, the above-mentioned measures provided for moving the construction equipment at the end of the winter season. In the first quarter of this year additional special-purpose columns of workers were organized for the following tasks: to build access roads for year-round use; to build operations thoroughfares along the pipeline rights-of-way; for the hydraulic filling of earth into dump holes [rezerv]; to lay approach roads from soil pits to the right of way; to construct helicopter pads to be used in servicing sections to be built in the summer; to construct pipeline crossings through swamps and small rivers and to drain off water and ballast the pipeline. The subsections referred to above have been equipped with the necessary materials, equipment and tools.

Completing the assignments and measures of the program, production line S-5 completed the engineering and preparatory operations in good time, and finished all the basic line section operations on the Urengoy-Tsentr-1 section of the pipeline by mid-January, and had begun construction of the Urengoy-Tsentr-2 section with advance preparation of the sections with the most complicated conditions. Production line S-9 completed all the construction work on the Urengoy-Tsentr-1 pipeline at the end of March and started in on construction of the second line.

The Severtruboprovodstroy Trust has prepared a year-round thoroughfare on the Nadym-225th-km marker of the right-of-way, to be used for construction work in summer, and also for achieving high work rates on linear sections during the fourth quarter of 1984, and this trust has also constructed a major part of the thoroughfare along the right-of-way, along the 222-km-252-km stretch of the pipeline. Prior to 25 April, 30 km of pipe was brought in by the Kazymtruboprovodstroy Trust for the 567-653 km section, and 50 km of pipe is slated to be delivered into the region by the Verkhne-Kazymskaya KS [compressor station] during the shipping season. In accordance with the program, production line S-5 (under comrade Nikiforov) of Construction and Installation Administration 60, was charged with laying 28 km of pipeline during the summer, and production line S-9, (under comrade Mikhaylyuk), of SMU-42, is to construct 31 km of pipeline during the third quarter. The fact that in-house facilities have been set up for the manufacture of ferroconcrete overweights by the S-5 and S-9 production lines has utmost importance toward completion of the assigned tasks. This allows the subdivisions working on the complicated sections of the right-of-way, and those working with the overweights, to be kept at full strength without interruption and at most accordance with the construction transport schedule. The production lines also work on a subcontract with UM-14, which specializes in driving in AR-401 anchors. This makes it possible for the sections of the pipeline which are located in swamps and flooded areas to be ballasted according to the plan throughout the entire year, to significantly decrease the distance freight has to be hauled, and as a consequence, to reduce outlays for transport and improve the quality of the pipe-laying and the effectiveness of the production lines' efforts.

The outdistancing completion of the engineering and preparatory measures permits, in spite of the lack of special swamp-traversing equipment, not only that the production lines work uninterruptedly and rhythmically on the compli-

cated right-of-way in summer, but that conditions are created which will increase the work rates and productivity of the production lines in winter as well. On the whole, the year's productivity for the S-5 and S-9 production lines (according to the assignment and actual completion) is 30-40 percent greater than the average for the other production lines working in similar conditions. A smooth-running operation and the absence of overtime shifts and rush work exerts a positive effect on the work attitude of the production line collectives, raises the skill level of workers' activity and permits efficient planning of the work process, personnel training and leisure time.

In order for construction to be put on a year-round basis, a number of problems need to be solved. Thus, at a stage in the planning of the operation, the planning organizations, in cooperation with the trusts, must determine and select which sections will be constructed during the summer months, and for which the necessary expenditures must be provided for building access and operations roads. Norms for outlays of labor are required for the entire complex of operations envisaged for the construction year.

In order for pipelines to be constructed successfully in Western Siberian regions, two-year planning periods should be provided for construction of the sections, so that operational and access roads can be built up to them during the most favorable times of year, the engineering and technical preparation of the right-of-way (including preparation of assembly areas and facilities, deliveries of pipe, pipe sections and curvilinear insertion pieces) can be completed, transfer moves over to the complicated sections can be completed and the necessary land reclamation operations can be carried out within the construction zone.

Glavsibtruboprovodstroy's experience has shown that the most workable direction for increasing the volume of pipeline construction during the summer is to maintain leading rates of construction on permanent roadways of various types, including pouring off an earthen road-bed onto synthetic, non-woven materials, building roads using the non-commercial timber obtained during clearing of the construction zone and filling-in of roadbeds by hydromechanical means etc. (Figures 1 and 2 omitted; see Figure 3). Along with this, thermosiphons, designed by the Karelo-Finnish All-Union Scientific and Research Institute for Main Pipeline Construction, are used during construction of winter-use roads, and these thermosiphons make possible a hastening of the beginning of, and an extension of the operational period of, ice-crossings over the Nadym and Kazym rivers, and they also promote a thorough freezing-through of the deep (grade I-III) peat bogs (Figure 4).

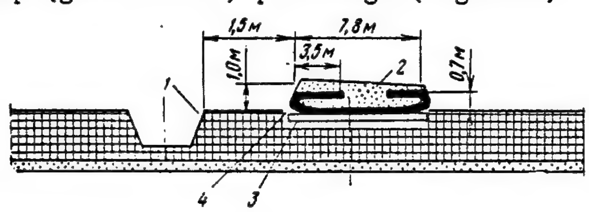

Figure 3. Road-bed design (Type IV). 1--trench; 2--fill; 3--wooden flooring; 4--layer of non-woven synthetic material

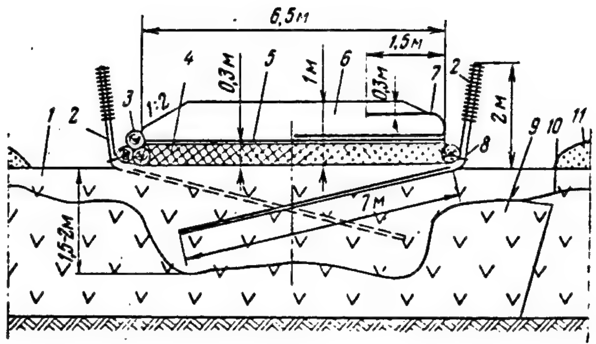

Figure 4. Road bed with freezing intensified by thermal insulation and thermosiphons. 1--frozen peat layer of swamp; 2--thermosiphon; 3--logs, laid lengthwise; 4--thermal-insulating layer of peat; 5--scraps from trees felled during right-of-way clearing; 6--sand; 7--non-woven synthetic material; 8--fastener; 9--unfrozen layer of swamp; 10--mineral base of the swamp; 11--snowbank.

Since planning institutes have changed over to the single-corridor design for planning pipeline systems in the last few years, we feel that it would be advisable to organize specialized road-building subdivisions to construct roads along the pipeline routes, and also industrial roads. The problem of equipping construction organizations involved in road construction with special equipment needs to be put in order: they will need tree-felling equipment, stump pullers, pincer-type loaders, skidder-haulers, graders, heavy-duty dumptrucks, all-terrain tractors, bulldozers and excavators for use in swamps, and other equipment.

At the first stage, solutions to the problems which we have considered is already allowing the organization and adoption of year-round construction to tangibly increase the yearly output of the integrated production lines, to increase the number of pipelines constructed, to reduce the time spent in their construction and to improve the operational reliability of the systems which have already been built.

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ASTRAKHAN FIELD PIPELINE CONSTRUCTION DISCUSSED

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 9, Sep 84 pp 8-9

[Article by V. I. Fedorov, of the Main Oil and Gas Installation Administration,"Construction of Gathering Lines in the Astrakhan Field"]

[Text] The task of increasing gas-condensate recovery levels has been set for the 11th Five-Year Plan period. There is a great amount of work which must be completed at the Astrakhan gas-condensate field, the gas from which contains up to 26 percent hydrogen sulfide. There are special requirements regarding the construction of pipelines for transporting this gas.

Construction has begun in 1984 on gathering-pipelines in the Astrakhan gas-condensate field. Construction of these pipelines is based on the experience gathered from laying pipeline systems which transport nonpurified gas containing hydrogen sulfide admixtures of up to 6 percent.

In 1969-1970, for the first time in Glavneftegazmontazh practice, work on the construction of gas-condensate fields in Orenburg and Uzbekistan was begun, the gas from these fields containing up to 6 percent hydrogen sulfide.

Technical decisions called for the gas to be transported from the wells to the gas-processing facilities through pipes having an epoxy lining on their interiors for protection of the pipe metal from the corrosive medium (moisture + hydrogen sulfide). But in practice, these decisions were difficult to bring about, due to the impossibility of insulating the field erection joints in field conditions. Other means of protecting the metal of the pipe from corrosion were recommended by various institutes. It was suggested that the welded joints be heat-treated to protect them from corrosion and hydrogen fracturing.

It was also recommended that the resistance welding method be used on the joints, during which heat treatment would not be required. Pipes with a diameter of up to 168 mm were welded on TKUS-1A electrocontact rigs using an SG-1 welding head. The pipe and connections used for the pipelines were of Grade 20, 12X1MF and 20YuCh, with a diameter of from 57 to 1020 mm and a wall thickness of from 5 to 22 mm. It should be noted that a great number of the joints, made by the electrocontact welding method were excluded from use due to the differing thicknesses of the pipe joint end perimeters.

Pipes over 168 mm in diameter were joined by manual electric arc-welding using TsL-39, TsL-20, UONI 13/55, "Garant", FoksYeV-50, VSU-4 and Fokstsel welding rods, 3-4 mm in diameter, and AN-348A flux and Sv-08GA, Av-08AA and Sv-08A welding wire, 2-3 mm in diameter,was used for automatic welding. All the welded joints on the pipelines, from the combined gas-preparing installation to the gas refinery and on their territories, in the areas from the wells to the combined gas-preparing installation, in areas of underwater crossings and flood plains, in highway and railroad track crossings, and also backlashes [zakhlesty], catheads [katushki] and places where fittings were welded after heat treatment, were all subjected to a 100 percent check via X-ray or gamma-ray inspection, with a random-sample back-up check of either 20 percent of the joints welded by each welder, or a check by a brigade using an ultrasonic or recording magnetometric device.

Following heat treatment, the joints on the remaining sections of the connecting pipelines from the wells to the combined gas-preparing installation also underwent a 100 percent check: 25 percent of the joints were X-rayed and 75 percent were checked by either ultrasonic or magnetometric methods.

For heat treating welded joints in field conditions, OTS-121 and OTS-62 model equipment was used as part of a set of equipment which includes PTO electric muffle furnaces and LTP-1 thermal laboratories.

Pipeline joints of 108 mm and less, having wall thicknesses of 6 mm and less were heat-treated by the high-speed method: they were heated up to 660^{+0}_{-40}°C, held at a temperature of 600° C for 30 minutes; heating-up speed was 600° C/hour, and they were cooled together with the oven to 300°, and were then cooled the rest of the way out in the air.

For welded pipeline joints, at which the plan calls for protection from the internal action of a corrosive medium through inhibition, the following heat-treatment method is called for: the joint is heated up to 600^{+0}_{-40}°C, the temperature is held at 600° for 60^{+20}_{-0} minutes, the heat-up speed is 600^{+0}_{-40}°C/hour and the joint is cooled with the furnace to 300^{+0}_{-40}°C. At temperatures lower than 300° C, the cooling process was not controlled, and was accomplished either with the furnace or in the air. The hardness, following the heat treatment, was checked on 10 percent of the joints at three points: the metal of the weld, the area affected by the heat at a distance of two mm from the fusion line, and the base metal at a distance of 50 mm from the weld.

During the initial period of construction of the gathering-pipelines in the Astrakhan field, certification of all engineering and technical workers and field test laboratory personnel was carried out on their knowledge of standardizing documents, and maintenance requirement cards for setting up and welding pipe joints were drawn up.

Each arc-welder, prior to being allowed to set about welding a tolerable 168 millimeter-diameter joint, underwent training, and welded no less than 20 joints. Twelve welders, including two trained on automatic welding machines, were certified to carry out welding and assembly operations. They work on

pipelines of the following dimensions: 114.3 X 7.1, 168.3 X 11 and 406.4 X 20.6 mm. The welding rods which are used have a basic type FoksYeV-50 brand coating, designed for special-purpose requirements. Automatic welding of pipe of 406-mm diameter is done with S2 gage wire, 2.5 mm in diameter, which uses LW330 ceramic flux.

The speed of automatic machine welding, 18-20 m per hour, is insufficient. We need to develope a technique for welding full-circle joints at increased rates, which would provide the needed impact strength and resilience, and resistance of the welded joints in wet hydrogen sulfide.

Increased demands regarding the preservation of weld materials are made on construction of gathering-pipelines which transport corrosive gas. Hydrogen-free welding rods should be stored in dry, heated spaces. Storage temperature should be no lower than 18° C. The relative humidity of the air should not exceed 60 percent.

The use of storage boxes for welding materials at the Astrakhan gas-condensate field assembly area has been stipulated by special measures. However, to date no boxes have been manufactured.

After the welding rods are thoroughly dried out, if they are not used right away they should be stored inside warmed portable containers until the moment they are to be used. This intermediate storage must be carried out at a temperature of 60° C. The welding rods must not be stored in the warmed containers longer than 10 days.

High demands are imposed on the assembly and welding of gathering pipelines.

When fitting the joints, interior misalignment of the pipe edges must not exceed 1.6 mm, and local [mestnoye] slippage must not exceed 2.4 mm. This requirement makes assembly more difficult. The pipe used in construction has uncalibrated ends.

The tack welds are ground smooth on both ends of the pipe, and after laying down a welded bead, the arc-welding crater is ground off. The welded seam is cleaned off in layers with a little grinder. The maximum seam reinforcement for pipes with wall thicknesses of up to 25 mm is 2.5 mm, and 3.5 mm for pipe with wall thickness of up to 50 mm. Faulty fusion of less than one millimeter's width is not allowed. This requirement is caused by the need for the inhibitor to penetrate to the root of the weld. We are able to disallow the presence of faulty fusion in the root of a weld less than one millimeter wide only by virtue of the more precise assembly of the welding stand along its horizontal axes and the shortened distrnce between the supports at the assembly and welding site.

Welded joints which are made with an electric arc welder have minor defects as a rule. If the size of these defects does not exceed the dimensions acceptable according to the standardizing documentation, they are not liable to be

corrected. However, this condition must be checked thoroughly with the aid of densitometers. Densitometers are needed which have conical checkers with a diameter of about one millimeter, which corresponds to the width of the grooves of the sensitivity calibrations which are now in use. It should be noted that welded joints on gathering-pipelines are stipulated to be checked only with D-7 X-ray film. Reliable and long-lasting X-ray devices are necessary for use with this film. Introduction of the experimental "Siren" model intra-pipe device is scheduled for this year at the Astrakhan gas-condensate field. The experience of installing gathering-pipelines for unpurified gas attests to the advisability of using Iridium-192 as a source of radioactive radiation for checking the quality of welds, including and combined with the "Siren"-type self-propelled devices.

One hundred percent of the circumferential welded joints on pipelines transporting gas with a high sulfur content are checked radiographically, and 25 percent are checked by the ultrasonic method following heat treatment. One hundred percent of the corner-welded joints and the bell-and-spigot welded joints are checked by the ultrasonic method, the magnetic powder method or by the penetrating liquid method.

After being checked radiographically, the welded joints undergo heat treatment. The temperature of the heat treatment must be in the 550°-580° C range. The heat-up speed is no more than 250°C/hour. The heat is maintained for two minutes for each millimeter, but must be no less than 30 minutes. The cool-down rate must be no more than 200°C/hour. Cooling is done using the furnace down to 300° C, and then in the air. After heat treating of the welded joints, hardness is checked on 100 percent of the joints by a "Pol'di" instrument.

A new method of improving corrosion resistance in circumferential welds on pipelines has been proposed by the Arc-Welding Institute imeni Ye. O. Paton: explosion treatment. This progressive method of thermal treatment should be adopted in the construction of pipelines which transport unpurified gas.

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USE OF ARC-WELDED PIPE FOR PIPELINES DISCUSSED

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 9, Sep 84 pp 9-11

[Article by A. S. Bolotov, of the All-Union Scientific and Research Institute for Main Pipeline Construction,"The Prospects for Using Arc-Welded Pipe Made of Economically Alloyed Steels"]

[Text] A basic trend in increasing effectiveness in the use of pipe for main pipelines is the use of controlled-roll, mildly pearlitic, economically-alloyed sheet and rolled steels in pipe production.

Controlled rolling, as a method of thermomechanically treating metal, permits production of low-alloy steels with a combination of properties which can be achieved at present by complex alloying with scarce elements or expensive heat treating methods. Controlled rolling increases the properties of strength, impact strength and cold strength of sheet and rolled steel. These are properties which determine the specific quantity of metal used in the pipe and the resistance of the metal to brittle and prolonged tensile failures. It is important that the build-up in the above-mentioned properties be brought about by using low-carbon, mildly pearlitic steels, which possess improved weldability in plant and field conditions.

The widespread use of controlled rolling to produce sheet steel has been brought about, to a great extent, by the development of methods of treating liquid metal outside the furnace, including vacuum processing, treating with calcium, synthetic slags and rare-earth metals, argon lancing and electromagnetic stirring. Treatment outside the furnace makes it possible to clean sulfur and nonmetallic inclusions from the metal, and to improve the homogeneity of the steel and increase the level of impact strength.

The present-day controlled rolling method of producing steels regulates not only the system of micro-alloying and the degree of reduction during the rolling process, but also the routines for heating the slab and cooling the rolled products.

The singleminded treatment process, which utilizes maximum purification of the metal, the special features of matrix strengthening by microalloyed elements, the recrystallizing processes of the austenite and its strain hardening, and also the process of polymorphic conversion $\gamma \rightarrow \alpha$, lead to the production of

steel having an extremely fine-grained ferrito-pearlite structure.

The successes of the metallurgical industry over the last few years are linked to the production and assimilation of controlled rolling, low-pearlite sheet steels of 09G2FB grade and class K56 hardness. This steel is sparingly alloyed with niobium (up to 0.05 percent) and vanadium (up to 0.08 percent) and is purified of sulfur ($S \leqslant 0.01$ percent). Arc-welded straight-seam pipe with a diameter of 1,420 mm and a wall thickness of 17.5 and 16.8 mm made of 09G2FB steel, is used widely in construction of main gas pipelines rated at an operating pressure of 7.5 MPa. The pipe metal meets the requirements imposed on pipe used in the North: the transition temperature when brittle, which is determinable by an 80 percent constituent of fibrosity in the fracture of densely-thickened DVTT [not further identified] models, is 15° C and lower; and the level of impact strength when tensile according to the results of a Charpy test, is not lower than $78.4 \cdot 10^4$ Joules/m^2.

Pipe with a diameter of 1,420 mm, having a rated operating pressure of 7.5 MPa, made of new niobium-free controlled-rolling 10G2F and 10G2FT grade steel, and having a class K56 hardness, and in which titanium microadditives perform the functions of niobium, has been tested in production and has successfully passed proving-ground tests. In the indicated steels, the vanadium and manganese content has been increased somewhat (to 0.12 percent and 1.70 percent, respectively). The introduction of pipe made of these grades of steel instead of the 09G2FB steel has made it possible to reduce expenditures in pipeline construction through a reduction of the prime cost of pipe by 12 rubles/ton, or 7.5 rubles/meter through savings in inobium.

Use of the new low-pearlite, controlled-rolling 10G2FB steels, of class K60 hardness is even more cost effective. The use of this brand of steel plate to produce pipe of 1,420 mm diameter, with a rated working pressure of 7.5 MPa, permits a reduction in the rated thickness down to 15.7 mm, which reduces the quantity of metal in the pipe by 6 percent, in comparison with the specific quantity of metal of pipe of 1,420 X 16.8 mm size, made of 09G2FB steel and reduces the amount of weld-seam metal used in welding along the pipeline by 12 percent and consequently increases the speed at which main pipelines are constructed. Increasing the strength rating of the steel while leaving the chemical composition practically unchanged permits a reduction in the prime cost for one meter of pipe of 5-10 rubles by reducing the thickness of the pipe wall. The planned increase in the working pressure of future gas pipelines up to 10 and 12 MPa requires the use of steels having strength ratings of no less than K60 and K65 respectively in order to insure that main pipelines are constructed according to procedures which have been developed for welding and assembly and laying operations.

A technical and economical analysis of the different aspects of construction of pipelines working at a pressure of 10 MPa has shown that it is most advisable to manufacture pipes with steel having a K65 strength rating. This strength can be achieved through controlled rolling of non-pearlite steels having a ferrite-bainite or bainite structure.

Bainite structures can be obtained through the controlled rolling of steel having an extra-low carbon content (up to 0.06 percent), the system of alloying of which uses microadditives of niobium, titanium and boron, or accelerated cooling of low-pearlite steel immediately following the controlled rolling. In any case, the cooling speed must be such that the austenite is not converted into a ferrite-pearlite mixture, but forms a ferrite-bainite or completely bainite structure.

The sparingly-alloyed bainite-structured steels are capable of providing the exacting properties needed for pipeline pipe requiring thicker walls, rated at working pressures of 10 MPa and higher.

Research has shown that the ferrite-bainite structure is obtained as a result of accelerated cooling of the sheet steel blank immediately following the controlled rolling of the slab from the low-temperature deformation range (the NKPU [not further identified] process). Here, in order to obtain steel of K65 class hardness, 10G2FB grade, economically alloyed steel may be used, and for K60-class strength steel, 10G2FT grade steel may be used.

Steel plate having a completely bainite structure and a K65 (or higher) strength rating may be obtained by controlled rolling with accelerated cooling of the steel and alloying with microadditives of inobium, titanium and type 03G2BTR boron.

The use of strength class K65 steels instead of K60 steels permits a 7.3 percent reduction in the specific quantity of metal used in arc-welded, 1,420-mm diameter pipe, which is used at a working pressure of 10 MPa, with a reduction of 14.3 percent in the volume of welding operations along the pipeling route, and a reduction of approximately 8 rubles in the prime cost per meter of pipe.

Bainite structure steels having a strength rating of K65 are also used for pipe having a rated working pressure of 7.5 MPa, the thickness of their walls being 14.5 mm. The economic effectiveness of using pipe made of these steels instead of 1,420 X 15.7 mm-sized pipe which has a K60 strength rating is determined by the 7.5 percent reduction in the specific quantity of metal used, and a reduction in the amount of metal built up during welding, of 14.7 percent.

Thermally strengthened pipes made from Type 17G1S-U sheet and rolled steels, which are simple in their metallurgical composition and which have undergone excellent technological development in production can compete with arc-welded pipes made of controlled-rolling steels having a strength rating of K65. Thermal strengthening of pipes, which includes quenching and low-temperature tempering, allows a simultaneous increase in the strength chapacteristics and the cold strength of the steel, thanks to the effective comminution of the grain of ordinary ferrite-pearlite steels. Treatment of welded joints by heat, during which residual stresses are completely relieved and the strength and low-temperature impact strength are increased as much for the built-up metal as for the pipe metal near the weld, also promotes an increase in the workability of thermally-strengthened pipes [1].

Heat strengthening of spiral seam pipe, which is manufactured from extremely inexpensive rolled steel, is particularly effective. The spiral welded seam helps to keep the contour of the pipe within tolerances during the time it is heated as part of the tempering process.

Ten years of experience in the commercial production and use, in pipeline construction, of thermally-strengthened spiral-seam pipe of 820-1,220 mm diameter, K60 strength rating, and 5.5 and 6.4 MPa operating pressure, which is made of 17G1S and 17G2SF rolled steel with a K60 strength rating ($\sigma_b \geqslant 589$ MPa) has made it possible to develop and assimilate the technological process of thermally strengthening 1,420 X 15.1-mm pipe made of 17G1S-U steel with a K65 strength rating to be used for main gas pipelines operating at a working pressure of 7.5 MPa. Proving ground tests of an experimental-commercial batch of these pipes demonstrated their high degree of workability, provided by increased resistance both to brittle failure and stress impact failure. Based on the results of the field tests, the thermally strengthened pipes were recommended for use in construction of main gas pipelines in all the climatic zones of the country.

The economic effectiveness of thermally strengthening pipe comes from a reduction in the pipewall thickness of 12-15 percent, and the use of inexpensive 17G1S rolled steel, which contains no inobium or vanadium, and amounts, for pipe with a strength rating of K60, to 22.3 rubles/ton [2].

Straight-seam pipes, in 1,020 and 1,220 mm diameters, rated at working pressures of 5.5 and 6.4 MPa, and which at present are made of 17G1S and 17G1S-U normalized sheet steels holding a K52 strength rating are used in pipeline construction. In order to insure strength and high resistance to cold, it is advisable to substitute normalized steels for controlled rolling steels for 1,020 and 1,220 mm diameter pipes. Replacing 13Gs grade controlled rolling steel with 17G1S-U normalized steel of the same strength rating, i.e., K52, permits a reduction in the prime cost of 1,020-1,220-mm diameter pipe, by virtue of omitting the sheet normalizing process and reducing the brittleness transition temperature, thereby insuring the suitability of these pipes for use in northern conditions.

The effectiveness of using controlled-rolling steel for pipe with a diameter of up to 1,220 mm can be additionally increased by increasing the strength grade up to K56, with a corresponding reduction in the thickness of the walls. TsNIIchermet [Central Scientific and Research Institute for Ferrous Metals] has developed technical conditions [3] for 09GST grade controlled roll sheet steel, which is characterized by low (up to 0.11 percent) carbon content. Sheet 09GST steel provides temporary blowout resistance at 548-666 MPa and a yield strength of 450-548 MPa. Taking the increase in the guaranteed strength characteristics into consideration, the specific quantity of metal used in 1,020 and 1,220 mm diameter pipe can be reduced by 7 percent on the average, and the volume of welding and installation work on the pipeline route can be reduced by 15 percent.

Sheet steels of 13GS and 09GST grades and K52 and K56 strength ratings can be obtained via high-temperature controlled rolling of the cast ingot, with accelerated cooling of the sheet (the VKPU [not further identified] process). This reduces the price of producing sheet steel, and the main thing is that it permits the use of the output from metallurgical works which manufacture steel in open-hearth furnaces.

Thus, in prospect, the widespread use of arc-welded pipe made from high-strength, economically-alloyed controlled rolling steels, and thermally strengthened pipes, will allow the specific quantity of metal used in to-be-constructed gas and oil pipelines to be lowered considerably, as well as expenditures for installation and welding operations, while at the same time increasing the rates and improving the quality of construction.

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PIPELINE CONSTRUCTION

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NEW WELDING MATERIALS DISCUSSED

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 9, Sep 84 pp 14-15

[Article by V. D. Tarlinskiy of the All-Union Scientific and Research Institute for Main Pipeline Construction, "New Welding Materials"]

[Text] Not only the reliability of welded joints, but also the capacity of the weld seam depends on the quality and properties of the welding materials. For example, making powdered iron part of the electrode, or feeding filler metal directly into the weldpool during automatic submerged arc welding allows a 25-40 percent increase in the capacity of the weld seam, and, as a result, in the productivity of welding operations.

To a great extent, welding materials determine the rate at which welding and installation work proceeds during the construction of main pipelines. Had the root seams of the welds not been welded with cellulose electrodes, it would have been impossible, in 1975, to develop organizational flow-charts for the straight-line-partitioned [raschlenennyy] method of operation.

The approved procedure of welding root seams and making a hot pass with the same cellusose electrodes allowed the adoption, at the end of the 70's, of a method of automatic welding for non-rotary [nepovorotnyy] pipe joints with forced-weld flux-cored welding wire.

During the stages of its development, gas and oil pipeline tubing production has entailed a change in the list of welding materials products.

At the first stage (prior to 1956) of pipeline construction, when pipe made of non-alloyed commercial-grade steels was being used, they used electrodes in those days which were series produced and which were covered with a mining-acid [rudnokislyy] coating, which had very mediocre properties of workability for welding in all spatial attitudes, and which had a low level of mechanical properties. After that, low-strength electrodes with a basic type of covering were used, and at this time the first pipe-welding facilities appeared, and they began using general-purpose OSTs-45 grade silicate flux for rotary welds.

At the second stage (1957-1965), in connection with the need to increase the temporary resistance of the base matal to fracture, and to strengthen the requirements for the quality of welded joints for non-rotary welding, they began

to use only electrodes with E50A-B type basic coating, and at the pipe welding facilities which were specialized for welding circumferential joints, they used AN-348A flux in combination with Sv-08GA magnesium wire. At the end of this period, in connection with the initiation of construction on the above-ground pipelines in the country's northern regions, the need arose to increase the impact strength of the metal of the weld. For this they had to use AN-22 flux, which had been developed earlier for other purposes, and which had higher basicity than AN-348A flux. As with any other flux having increased basicity, the AN-22 flux turned out to be ineffective for welding circumferential joints, as it provided poor slag separability and metal was formed which was prone to pore formation.

The third stage (1966-1984) was marked by the appearance of large-diameter pipe made of fundamentally new steels, the strength of which is provided by the combined effect of controlled rolling and the microalloying of the metal with dispersoid elements. By the beginning of this period, the VSTs-4 cellulose electrodes and the VSF-65U electrodes had already been developed in the VNIIST [All-Union Scientific and Research Institute for Main Pipeline Construction]. However, since the new grades of increased-strength pipe had excessive carbon and dispersoid element content, and reduced weldability as a result, welding of the root layer of the seam continued to be done with electrodes having a basic covering, by a small number of brigades, and with no segregation of the welding operations. In the middle of this period, after painstaking investigations of the metallurgical weldability of these steels and the imposition of specific requirements regarding their chemical composition, VNIIST developed a combined welding procedure by which the root run and the hot pass of the weld were done with cellusose electrodes, and the filling course was done using VSF-65U electrodes. The combined method opened the way to flow-type and separated organizational production flow charts for the overhead welding of large diameter pipe.

Right at this time the Institute of Electric Welding imeni Ye. O. Paton jointly with VNIIST developed AN-47 silicate flux, which united the excellent welding and technological properties of the AN-348A flux and the high level of mechanical properties which are characteristic for AN-22 flux. In a short time, the AN-47 flux completely supplanted AN-22 flux in the pipe-welding facilities. As a result of these developments, the industry succeeded in bringing about a significant increase in the productivity and an improvement in the welding quality of rotary and non-rotary welds on pipe made of increased-strength steels.

Progress in the area of pipe steel production continues. The use of intensive thermomechanical treatment and combinations of dispersoid elements (sometimes together with 0.002-0.004 percent amounts of boron) permits a drastic reduction in the carbon content and in the total dispersoid content of the base metal, which creates prerequisites for improving the production weldability with a simultaneous increase in the level of its mechanical properties. This contributes to the further spread of cellulose electrode use. However, intensive thermomechanical treatment of pipe causes a number of problems concerning metallurgical weldability. In addition, the increase of the working pressure

to 10-12 MPa unavoidably involves the manufacture of pipe with thicker walls. These circumstances call into being a new concept in the field of welding materials.

Two fundamental ideas have been formulated which are suitable for electrodes. The first is the use of 5-5.5-mm cellulose electrodes for welding filler layers. By increasing the productivity of the beading, these welding materials increase the productivity of welding operations by 25-30 percent. The VSTs-60 electrodes were developed in the VNIIST based on this. The introduction of specially developed combined hardeners into the electrode coating increased the strength of the metal of the weld without harming the welding and technological properties of the electrodes.

The second idea concerns the effectiveness of uniting the advantages of cellulose and basic electrodes into one class of electrode. So, based on this, electrodes with a basic VSO series coating were developed in VNIIST for welding by the "top to bottom" method. The use of these electrodes has increased the productivity of welding operations by 20-25 percent.

These electrodes, while being somewhat inferior to cellulose electrodes as far as linear welding speed in the case of welding the root layer of the seam, are at the same time devoid of a number of their faults. In particular, slagging pockets are eliminated, the shape of the welding bead is improved, the hot pass is no longer needed, and in a number of cases preliminary heating can be avoided etc. Production of a multilayer weld when welding filler layers with beads having high linear speed (20-23 meters/hour) provides not only needed impact strength to the metal of the weld (which is higher here than when welding by the combined method, not to mention when using the cellulose variety), but also provides increased impact strength to the metal near the weld, which is important from the viewpoint of the metallurgical weldability of the new thermomechanically and thermally strengthened pipes. In the welding of filler layers, VSO series 4-mm diameter electrodes are completely competitive, as far as productivity of the weld seams is concerned, with 5- and 5.5-mm VSTs-60 electrodes, and they splatter less.

At the present time an increase is planned in the volumes of bilateral submerged arc welding to be implemented. The effectiveness of BTS-type bases will be determined to a great extent by the linear welding speed and the properties of the welded joints, first of all the impact strength of the area near the weld. Fluxes are needed for welding thick-walled metal at a linear speed of 80-120 meters/hour. AN-47 flux is becoming sufficiently effective in these conditions.

AN-VS flux has been developed by VNIIST conjointly with the Institute of Electric Welding imeni Ye. O. Paton. High-silicate flux was taken as a basis. In order to avoid making its technological properties worse, the high-silicate and the oxidizing parts of the flux were separated. Separation of these parts made it possible to prevent metallurgical reaction at the stage at which the flux melts. Iron oxides from the oxidizing part "meet" silicon and magnesium oxides from the high-silicone part only in the weldpool, providing the requisite physical properties for the slags during the metallurgical reaction.

In order to provide high linear welding speed, the high-silicate part of the flux must have a pumiceous structure, and the oxidizing part must have a glass-like structure. The documentation for AN-VS flux production is consistent with that of the plan-manufacturer.

Thus, the basic trends in the development of welding materials for the next stages of pipeline construction consist in consolidating the advantages of the highly recommended individual welding materials which were created during the preceding stages.

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PLASTIC PIPEWELDING EXPERIMENTS DISCUSSED

Moscow STROITEL'STVO TRUBOPROVODOV in Russian No 9, Sep 84 pp 28-29

[Article by K. I. Zaytsev, of the All-Union Scientific and Research Institute of Main Pipeline Construction, "Causes for the Reduction in Long-Term Strength of Welded Joints in Thermoplast Pipes"]

[Text] In the contact zone of weldments there occurs a flow of microvolumes of liquid polymer which permits the removal of a gaseous interlayer, and, to a great extent, the elimination or breaking down of other ingredients, thus preventing the convergence and reaction of the macromolecules.

Establishing the incidial value of the melt in the formation of welded thermoplastic joints, and also the enlistment of the results of the basic research in polymer rhyology and the processes of heat-mass transfer has made possible the creation of a theoretical basis for welding thermoplasts and, in particular, the development of calculating and experimental methods of determining the basic parameters of welding them [1].

On the basis of an analysis of the results of experiments conducted in VNIIST [All-Union Scientific and Research Institute for Main Pipeline Construction] on welding thermoplastic pipe at different pressures and setting speeds, the dependence linking the strength of the welded joint σ_z with the setting speed v_{cs} (melting speed in the contact zone) and the viscosity of the melt was obtained [2].

It has been proven [3] that at a low setting speed, the surface films of the ingredients preventing reaction of macromolecules in the contact zone of connected components do not split, but stretch, creating only adhesive bonds in the joint. At optimal speeds these films are not destroyed, and are to a great extent evacuated into the flash, and within the joint cohesive bonds are formed. At the very highest speeds, the films do not manage to be discharged from the joint.

This mechanism has also been confirmed by the results of research done with X-rays in the Institute of Electric Welding imeni Ye. O. Paton.

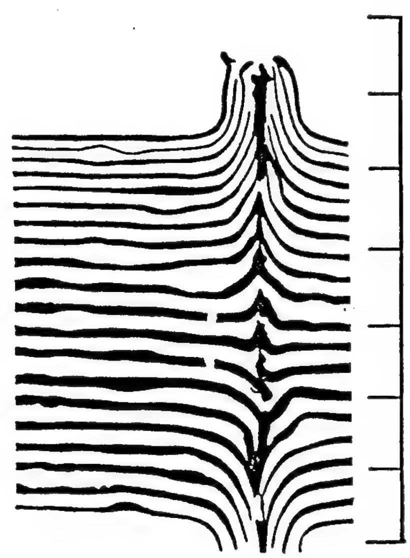
No one has succeeded in obtaining experimental quantitative data confirming the extreme dependence of the strength of welded joints on the setting speed

during the brief tests of the standard models of polyolefin, apparently because of the fact that these indicators for these polymers do not appear beyond the dispersion range of the data during the tests, i.e., the existing microdefects do not manage to increase up to the critical sizes in this type of test.

The dependence of strength on setting speed has been confirmed experimentally during tests of welded polyvinylchloride (PVC) joints, the tests being to determine the long-term strength in conditions wherein they were held under tension for up to 600 hours. However, in the publication on the results of this work [4] no explanations were given for the causes of the extremal connection of the setting speed with the indicator for long-term strength.

Investigations to determine the effect of the setting speed on the long-term strength of welded joints, and the effect of the setting speed on the speed of the melt flow in the joint, which were conducted in VNIIST, were done using several methods.

Prior to this, the rheogram technique had been developed by which the flow speed was determined along transverse cuts of welded joints of laminated test specimens (Figure 1). It is evident from Figure 1 that the flow speed of the melt at the discharge into the flash is higher by an order than in the center of the joint.



1. Rheologram of a welded joint of a seam of polyvinylchloride sheets, 25 mm thick.

The processes of the melt flow in the contact zone were qualitatively evaluated by another technique. Flat sheet samples of unstabilized (semitransparent) polyethylene and transparent polymethylmethacrylate were partially melted with a flat heater at varying values for the technological parameters (heater temp-

erature, contact time with the heater, pressing force), i.e., differing degrees of melting were obtained: from 1 to 3 mm. The 50-mm-wide samples were of a different thickness (from 2 to 35 mm).

Following the melting and separation from the heater, the sample faces (or one of them) were dusted with ferric oxide powder. No particle of the ferric oxide was larger than 3 micrometers. After the powder was applied, the samples were butt-joined and set at varying rates (at differing setting pressures). At the same time, depending on the degree of melting, the thickness of the sample and the setting rate of the applied pressure, the powdered ferric oxide is evacuated, together with the melt, into the flash at one or another stage. The distribution density of the brown oxide along the cross section of the butt-joint is observed here visually.

Experiments conducted by this method have shown that at setting rates of less than 5-7 meters/hour, 20-30 percent of the ferric powder is removed from the joint, and the remainder is uniformly distributed around the joint. At setting rates above 350 meters/hour, 20-30 percent of the powder is taken out in the flash, and the remainder is distributed non-uniformly around the joint, since approximately 40-60 percent of the remnant is concentrated in the area where it emanates into the flash.

The distribution pattern of the powder changes in relation to the thickness of the weldable samples. At thicknesses of 2-6 mm, a distinctive difference is observed in the distribution of the powder around the joint during the setting process, at setting rates in a wide range (2-40 meters/hour).

Experiments have been conducted by a special "hanging threads" procedure. The threads (filaments having a diameter of 0.2 mm, or copper wire with a diameter of 0.1 mm) were suspended, with no sags, on a frame at 1.5 mm intervals. After the borders of the sample sheets have partially melted, and prior to their setting, the frame with the threads was placed between the adjoining faces of the sample sheets. During the setting,as the melt flows in the joint, the filaments are enclosed and moved along with the stream. After cooling, cross sections are made and the distance between the threads is measured. Knowing the amount of time taken in setting, and as a result, the amount of time the melt flowed, one can determine the rate at which the melt flows within the joint with some degree of certainty.

The duration of the setting can be determined according to the diagram, which shows the variation in the degree of the setting from the time [Figure 2]. Using the setting time, we can calculate the amount cut off on the temporal axis by the perpenicular, which is reducible from the intersection point of the tangents traced along the growth curves which represent the extent of movement and the transfer curve into a horizontal, or almost horizontal position. A more exacting determination of setting speed is obtained with a graphic differentiation of the setting curve in time.

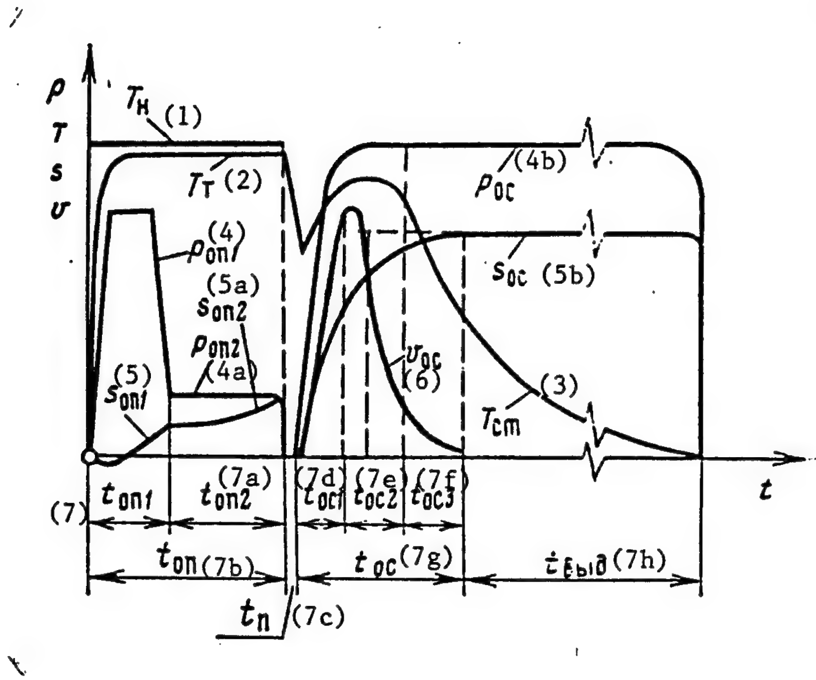


Figure 1. Schematic drawing of the thermomechanical cycle for resistance heat butt-welded thermoplastic pipe: (1) heater temperature, (2) temperature on face of plastic sample, (3) temperature in the joint; (4) pressure during initial period of partial melting, (4a) pressure during final period of partial melting, (4b)pressure during setting; (5) reduction of joint during initial partial melt, (5a) reduction of joint during final stage of partial melt, (5b) reduction of joint during setting; (6) setting speed; (7)time of partial melt at initial pressure, (7a) time of partial melt at final pressure, (7b) overall time of partial melt, (7c) process interval, (7d), (7e) and (7f) setting periods, (7g) overall setting time, (7h) hold time

An analysis of the variation in setting speeds during resistance welding of pipe by partial melting shows that three characteristic periods can be distinguished in time. In the first period (7d), the setting speed (6) also increases in proportion to the increase in pressure (4b). Having reached its maximum, it begins to drop off sharply, and the second period (7e) begins. However, in connection with the displacement of the layers of the melt which have high temperatures and the lowest viscosity, the melt flow speed gradually dies down. This corresponds to period (7f). They are different from one another in their duration, but, as a rule, the relation (7d)$<$(7e)$<$(7f) is preserved. The remaining time (7h) is needed for the joint to cool down, and for the relaxation processes to run their course. In the butt joint section, the melt flow speed is greatest at the exit from the joint [5].

It is well known that at a given deformation speed and with a reduction in temperature, thermoplastics change from a viscous-flow state to a highly elastic state, and thereafter to a vitreous state. Reversible and non-reversible deformations correspond to these conversions. It has been demonstrated [6], that at increased speeds of deformation, an irreversible deformation quickly decreases, but a reversible (highly elastic) deformation increases without interruption. This means that in an area where a highly elastic state is induced, their sum, equal to the overall deformation, occurs via the minimum. As a result, at high deformation speeds, a polymer in a state of flux displays the properties of an elastic body.

As applied to the case under consideration, i.e., the formation of a welded seam, the manifestation of this feature leads to the following conclusion. During high setting speeds, the rate at which the melt flows becomes so high that it becomes elastic, and its flow is inhibited, and the squeezing out of ingredients from the contact zone occurs with even less intensity than at lower speeds. Consequently, ingredients which have not been squeezed out may remain in the joint, which makes it more difficult to produce a cohesive joint.

It is also evident that as the remaining elasticity and heat-shrinking stresses are realized, defective structures are formed in the area near the flash. The micro-ruptures which are formed in this area during cooling [7] are the cause of future fracturing of the joint.

Thus, the reduction in the long-term strength of welded butt-joints occurs as a result of extremely low, or excessively high setting speeds, which provide no removal of the ingredients which prevent proper interaction of the micromolecules, from the joint.

At low setting speeds this occurs because of the insufficient intensity of the melt flow within the joint, and at high speeds it occurs as a result of the elasticity which has been induced. The totality of this effect with the process of heat contraction apparently increases conditions for the occurrence of microfractures in the zone near the flash.

During long-term operation under stress, the defects produced during welding in the area of the butt-joint, as well as the area near the flash, gradually enlarge, and may lead to a fracture of the welded joint around the area near the seam or around the butt-joint. This process of the enlargement of microdefects is intensified by the effect of surface active media.

The time which, in the recommendations and standardizing documents is called setting time, actually includes the time of the active flow of the melt, which consists of three periods (7d, 7e, and 7f in Figure 2), and the time needed for the cooling and the relaxation processes to occur. As a result, in order to determine the parameters for a welding routine, in order to calculate the setting time, we should calculate the sum of 7d, 7e and 7f (Figure 2), or even only 7d and 7e (Figure 2), since 7f (Figure 2) is the actual time during which the basic relaxation processes are occurring within the weld.

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CRIMEAN ELECTRIC POWER CONSERVATION DISCUSSED

Kiev ENERGETIKA I ELEKTRIFIKATSIYA in Russian No 3, Jul-Sep 84 pp 48, 49

[Article by V. M. Pinchuk, deputy general director, economic planning section of Krymenergo [Crimean Energy] Association, candidate of economic sciences: "Raising the Efficiency of Energy Fuel Resource Use"]

[Text] The coordinated optimization of future development of all energy delivery systems in the economy (electricity and heat supply; coal, oil and gas supply; and the essentially new nuclear energy system) is becoming exceedingly important at the present level of the energy fuel system's technical development.

In the Crimea, with the special features of its public production structure and its natural and climatic conditions, several future power supply trends, including factors that have a substantial effect on the composition of power medium, are being looked at.

Among these factors are:

--the shortness of the heating period, especially on the south shore of the Crimea;
--the generally moderate winter temperatures;
--the abundance of sunny days during the year, which makes it possible to utilize the sun's energy jointly with electric power for low temperature heating jobs;
--the huge expanses of sea which are heated by the sun during the spring, summer and autumn, but which during the short, mild winter do not release their accumulated heat into the surrounding atmosphere, making it possible to extract a substantial portion of that heat with heat pumps and to utilize it together with other types of energy to serve the economy's needs;
--the complicated nature of delivering hard and liquid fuels to areas without railroads, in particular to health resorts and to agricultural regions;
--the dispersion of power consumers, especially along the coast;
--the topographical complexity of the areas in southern and southeastern parts of the peninsula;
--the presence of [nature] preserves, etc.

Taking these factors into account makes it possible to change the nature of the energy fuel balance, introducing into it non-traditional power sources (the sun, the heat of the sea, geothermal waters, petro-geothermal sources, etc.). Potential supplies of power from these sources, the utilization of which is in principle possible, are quite large.

Research in these areas during recent years has developed extensively both in our country and in other industrially developed countries.

The Krymenergo Association took the first steps in this direction. At the present time on the Kerch Peninsula the first experimental solar power plant in the country is being built; it has a capacity of 5 megawatts (the first nuclear power plant in our country at Obninsk had the same capacity). At the 330-kilowatt sub-station Simferopol'skaya an experimental heat pumping installation has been tested, which makes possible the productive utilization of the heat from synchronic compensator cooling water; the heat is expelled into the atmosphere through a spray pond. It has been proven that such an installation would operate with an autotransformer.

It would be helpful to use the installation's heat for everyday communal or hothouse purposes as well as to increase the operating capacity of the equipment being cooled.

At the Sevastopol'skaya thermoelectric plant (TETs) a heat pump has been tested on sea water. In Simferopol, Alushta and Sudak experimental sites have been set up to do research on solar power as a heat supply. These activities have made it possible to determine more precisely the economic advisability of using non-traditional power sources, prospective trends in their use and the scale of their use.

The purpose of all these operations is to save fossil fuels in short supply, especially liquid fuels; to free a portion of the rail rolling stock engaged in transporting them; and to improve environmental conditions, primarily in the entire resort area.

The Crimea is a health resort of national importance. Therefore, it is very important to utilize rationally its territory primarily for rest, the healing properties of the climate and for agricultural production in order to provide the local population and the visitors seeking recreation with food as well as to provide large industrial and administrative centers of the republic and beyond with vegetables early in the year. The main business of this region is "the rest and [medical] treatment industry," and it is very important to maintain the appropriate healthful environmental conditions. Posing such a task arouses the need for additional improvement in power supply systems and the broader use of power resources that ensure these conditions.

It is generally known that the best type of power for these purposes is electric power, the use of which makes the maintenance of all the appropriate public health, comfort and other conditions possible.

Many scientific research organizations and individual specialists have done research on the comparative economic efficiency of various power sources. However, the special characteristics of the Crimean health resort region have not been reflected in this research. It is precisely for this region that questions about the greatest possible development of electrification have special importance, especially along its south shore, where the factors listed above raise the efficiency of fuel power resource utilization, especially electric power.

Let us examine several of them.

Utilization of solar power to heat living quarters and water is very important from the point of view of the rational utilization of fossil fuel. It is clear that in the Crimea it is impossible to utilize solar power for heat supply purposes the year around. At certain times it will be necessary to have electric heat delivery units. However, additional electric capacity will be required in order to do this.

A feature of the research results that is very important is that in a heat supply system "solar power plus electric power" to get a certain quantity of heat "Q," the amount of fuel expended is less than in a system in which a boiler is fired by fossil fuel.

Additionally, in the Crimea in the communal services sector and in the heat supply systems (excluding manufacturing) even with the abundance of solar radiation, high energy types of fuel are expended: gas, fuel oil, motor and stove fuel and graded coal. It is important to consider that the delivery of liquid and solid fuels to the southern coast of the Crimea or to remote agricultural sections of the region requires additional expenditures:

of electric power:

--for electric traction to transport the fuel by rail;
--for discharge and transfer of liquid fuel into liquid fuel storage tanks;
--for loading the liquid fuel into tank trucks for delivery to consumers;

of light oil products:

--for gasoline and diesel to fuel the trucks that transport the liquid fuel from the oil terminal to the consumer.

With the introduction of new systems of heat supply with non-traditional power sources about 1 million tons of liquid fuel and 30 million kilowatt hours of electric power now spent on fuel transportation and loading could be saved in the Crimea.

As a result of research conducted on new heat supply systems, coefficients have been calculated that raise the efficiency of the new heat supply systems: $C^{L}R \times E$ is the coefficient for the reduction of electric power expenditure when liquid fuel is replaced by electric power. Its size varies by year from 0.992 to 0.900; $C^{R} \times E_{h}$ is the coefficient of electric power expenditure

and required electric capacity in systems equipped with solar power installations. For Crimean conditions its value is 0.64.

To go to a new system of heat supply (with non-traditional sources of power) additional electric capacity will be necessary. If one proceeds from the actual consumers of thermal energy (which at the present time in the Crimea operate on liquid fuel), then, taking into consideration losses in the electric circuits, equivalent electric capacity for thermo-electric conductors will be needed by a factor of 1.3-1.6 less than thermal capacity. It has been established that when using solar power or thermal energy from the sea in a heat supply system, one may receive 1.3-1.6 units of equivalant power for each unit of expended electric power.

Solar power in Crimean conditions provides the opportunity to change not only the system of heat supply, but also to open up ways to successfully fulfill the USSR Food Program for the period until 1990 as it pertains to producing vegetables early in the season. The Program states: "The production of vegetables in protected soil must be considerably increased," and it further mandates the transformation of the southern regions of the country into the primary base for the supplying of warm weather vegetables to the urban populations of Central Russia, the North, the Urals, Siberia and the Far East.

The abundance of sunshine in the winter as well as the summer in the Crimea is, besides moisture and fertilizer, one of the primary elements in improving vegetable harvests in protected soils. On the basis of practical experience in growing early vegetables in the hothouses of the Crimean sovkhozes Gvardeyskiy, Sakskiy and others, it has been established that by increasing sunlight in the hothouses by 1 percent, production rises also by 1 percent, all other factors being equal. This is explained by the tendency of hothouse vegetation to absorb as much light as possible, especially in the winter, early spring and late autumn periods. At the present time in hothouses with electric heating on Crimean kolkhozes and sovkhozes, early vegetable harvests of 25 to 40 kg per square meter are produced. Therefore, early season vegetable production is more economical to develop in southern regions and particularly in the Crimean, and in so doing a substantial quantity of organic fuel will be released for other uses in the central part of the country.

Research data show that electro-thermal storing systems are more economical than heating boilers fired by coal. Electric boiler systems with solar installations (with thermal accumulation) are more economical than grouped and regional boiler systems fired by coal. Thermal pump installations utilizing the low potential energy of the Black Sea are more economical than all types of boiler systems fired by fuel oil, coal and gas by a factor of 1.3.

Thus, it has been established that if the introduction of electro-thermal heat supply is advisable in general throughout the country at this stage of its development, then for the Crimea (with its special features) the adoption of an electro-thermal heat supply together with the integrated use of solar power and low potential thermal power of the Black Sea and thermal waters

is economically and environmentally justified. The advisability of such thermal supply systems is determined also by the necessity to establish maximum levels of conveniences and comfort and by the opportunity to regulate thermal conditions and to improve the public health conditions in the resort areas.

Conclusions. Solar power, thermal sea water, hot spring waters and heat from deep within the earth are a great resource in the Crimean region for the expansion of power production. The integrated use of electric power with these types of resources, especially with thermal storage, points to the advisability of their adoption in new heat supply systems.

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GENERAL

FUEL AND ENERGY COMPLEX PROGRESS ANALYZED

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[Article by A. Reshetnyak and V. Khizhnyak, candidates of economic sciences, and A Tuzman, Donetsk: "Improving the Forms of Organization of Fuel and Energy Complexes"]

[Text] At the present time, the fuel and energy branches of industry are being developed on the basis of branch planning, which insures the execution of a unified technical policy, the creation of favorable conditions for improving technological processes, and the selection of effective areas for capital construction. However, management practice shows that the branch method of planning does not solve many problems involved in the integrated development of the economic systems of regions and interlinked branches of industry. The goals of territorial planning are, as is well known, the proportional, balanced development of the economy of regions on the basis of integrated utilization of resources, improvement of the production and social infrastructure, protection of the environment, and improvement of the ecological situation. The greatest effect is achieved when both planning principles are combined, because it is precisely in the area where branch and territorial planning meet that there arise many interbranch problems, which include--in particular--the problem of improving the effectiveness of the utilization of coal extracted in the Donets basin.

In the future, it is expected that the share of coal fuel in the Ukrainian SSR's fuel and energy balance will increase and that heat and power engineering in the republic will depend on the level of the development of coal extraction. This predetermines increased attention to the coal industry as one of the basic producers of power-generating fuel. Under the conditions of a strained fuel balance, it is of greater national economic importance to increase the production of electricity from each ton of coal that is extracted by having a higher degree of recovery of combustible mass during enrichment, improving the quality of the fuel, and improving its transportation, storage and combustion.

The questions of improving the quality and effectiveness of coal utilization during final consumption, as well as increasing the conversion of the combustible components in the extracted rock mass into enrichment products, have still not become basic ones in the operation of coal industry enterprises. The mass conversion of coal mines to gross extraction and the sending of the

rock mass to the surface predetermined, to a considerable degree, an increase in the ash content of extracted coals and a lowering of their energy potential. The increased content of free grains of rock and the high degree of dilution of the coal with extraneous inclusions from rock interlayers and wall rock make the direct use of it as the basic type of fuel in heat and power engineering extremely difficult.

In order to reduce the ash content of coal and improve its consumption properties, the rock mass must undergo mandatory enrichment, during the process of which the original qualitative characteristics are restored and, in some cases, are improved. Until now, however, it has been rare for coals for energy purposes to pass through this stage, because the production capacities of enrichment mills are considerably less than the amount of rock mass that is extracted.

There are frequent cases where multiply interbedded coal beds are not worked because their ash content is higher than the established quality requirements. These are the so-called unqualified (with respect to ash content and thickness) beds, the working of which under the conditions of existing mines, with subsequent enrichment of the extracted rock mass, would be considerably cheaper than the compensatory extraction of coal in newly constructed mines. This situation is explained, on the one hand, by the lack of appropriate economic levers, and on the other by departmental dissociation of the fuel producers and consumers. Conversion to an integrated form of organization of industrial organization on the basis of the formation of fuel and energy complexes broadens significantly the possibilities for improving the effectiveness of all public production and, in particular, that of the fuel and energy branches.

When selecting ways and methods for extracting and processing coal fuel for the production of electrical and thermal energy, strict observance of the principle of the national and not the branch economic effect is important. Such an approach makes it possible to consider not only existing, but also other possible technological plans for extracting and enriching coal, as well as the feasibility of their use from the viewpoint of obtaining the maximum final output for the least aggregate cost.

The integrated development of the fuel and energy branches of industry that are located in a single economic region can be realized by creating regional fuel and energy complexes. The economic nature of such production associations assumes a strictly determined set of production units that make up an economic system of the highest order in comparison with an individual enterprise. The presence not only of organizational unity, but also of technological-production and economic commonality and bonds, must be obligatory for the production units that are part of the complex.

The basis of the organization of such a complex is technological and production unity. For a fuel and energy complex, this means the inclusion in the association of enterprises for extracting, enriching and utilizing coal, and in some cases elements of the production infrastructure: transportation supply lines (primarily hydraulic pipeline transportation systems) and auxiliary production units.

The production complex concept implies a harmonic combination of enterprises that are united on the basis of the output of a single final product in a comparatively small area. Starting from this, it is correct to formulate the question of the creation of a new type of complex: the regional fuel and energy complex, which can be regarded as a specific form of territorial organization of production that insures an improvement in the effectiveness of fuel utilization. When such a complex is made up of enterprises engaged in extracting, enriching and utilizing coal, it can be regarded as a territorial subsystem, on the lowest level, of the UkSSR's fuel and energy complex that is called upon to assist in the develop of power engineering in the republic.

The basic element of a regional fuel and energy complex should be the branch that carries out the final stage of the production cycle. In the complex under discussion, the shaping nucleus is the heat and electric power plant. The other production units that form the complex are selected with due consideration for the satisfaction of the final unit's needs for fuel, and in their own activities are guided by the assignments that are common for the entire complex and are designed to insure the creation of conditions favorable for the achievement of the national economic goal.

During the formation of a territorial fuel and energy complex made up of enterprises that have been put into operation only recently, the following comparisons are made when calculating the economic effectiveness of such cooperation: direct costs for the creation of the basic production capital; related costs for allied production that provides the basic specialization nucleus with fuel of the appropriate quality; expenditures for the creation of transportation systems for the delivery of fuel to the point of consumption.

Enterprises that are part of a territorial fuel and energy complex are equal partners and must not lose their economic and legal independence. Some have local resources and are interested in their rational utilization; others have an output production assignment and the facilities for its realization, and try to carry out the production process with minimum total expenditures. The mandatory condition that should be imposed is the achievement of a unified goal; that is, to evaluate the complex's functioning, necessarily from the viewpoint of a global criterion. At the same time, the industrial elements in the complex transfer a number of their functions (such as controlling the fuel's quality) to a centralized administration. The set of centralized control functions is the organizational and economic basis for the transformation of the enteprises that are part of the complex into a single production system.

Integration in the solution of the problem of combining branch and territorial planning should be based on due consideration for the specifics and nature of the industry in the given region, as well as the features, principles of development and location of its branches of basic specialization. The formation of regional fuel and energy complexes should be aimed at the solution of the following problems:

discovering potential reserves for the intensification of the development of the fuel and energy base because of the involvement in the extraction process of unqualified beds and the corresponding development of enrichment capacities;

finding additional capabilities for increasing coal fuel reserves because of more rational enrichment methods;
improving the effectiveness of economic relationships on the basis of an improvement in fuel distribution methods and the securing of permanent suppliers for an extended period, eliminating irrational shipments, and introducing the hydraulic transport of coal intended for enriching mills and heat and electric power plants;
implementing integrated measures to improve the efficiency of coal utilization by improving the quality and blending of coal fuel delivered to heat and electric power plants;
preserving the environment under conditions of an increase in the unit power of power-generating units and electric power plants as a whole and an increase in the fuel's ash and sulfur content.

Orientation on the achievement of a better final result assumes proportionality and balance among a complex's production elements; that is, a correspondence between the volume and structure of production, on the one hand, and the volume and structure of consumption, on the other. As applied to a fuel and energy complex functioning in the territory of an economic region (which is not necessarily an administrative one), this means that its subunits must encompass all spheres of the production and final consumption of coal fuel. The production capacities of the complex's enterprises must be balanced and provide the requirements of the shaping unit. Under these conditions it is posible to achieve the efficient utilization of coal resources and insure a good final result.

On the level of a regional fuel and energy complex, the final result is its aggregate output of electrical and thermal energy, as generated by a GRES [state regional electrical power plant] or TETs [heat and electric power plant]. Individual elements of the complex (mines and coal-enriching mills) extract, enrich and blend the coal, and in some cases even transport it. These production processes are, however, technologically subordinated to the basic goal, which is the production of electricity. All the factors that contribute to the most economic operation of a heat and electric power plant and all possible ways of fuel economy are taken into consideration here. When functioning independently, each enterprise solves its own special problems without taking the final goal into consideration.

The practical solution of the problem of reducing coal fuel losses during its production is of an interbranch nature. It can be solved successfully if there is close interaction with the fuel-consuming branches, starting from the specific conditions for producing electricity (the capacity of the power-generating units, the system for the preparation of pulverized coal, the distance the coal must be transported and others) and the fractional composition of the rock mass that is to be enriched. With such an approach it is possible to determine the enriched product's optimum ash content. In this case the optimality criterion is assumed to be the maximum amount of electricity that can be obtained from a weight unit of coal for different enrichment variants, with due consideration for the factors involved in its utilization for the burning of pulverized coal.

An increase in the production of coal fuel can be realized in two ways. The first, or extensive, one consists of increasing the number of coal beds being worked, along with the number of mines, open-pit mines and enriching mills. The second, or intensive, one involves an increase in the production of coal reserves primarily because of complete recovery of the combustible mass and a reduction in losses during the extraction and enrichment of the coal. This makes it possible to reduce aggregate expenditures for the production of the final product. The saving of natural resources is cheaper for the national economy, by a factor of six to eight, than additional production of them. Intensive management methods, which are most fully realizable under the conditions present in a production association, agree with the direction of the technical policy at the present time: maximum reduction of specific expenditures per unit of production output.

Improving the organization of the fuel supply process is of no little importance for insuring the stable functioning of electric power plants. Right now the large heat and electric power plants have an extraordinarily large number of suppliers (mines and enriching mills). For instance, the Starobeshevskaya GRES has 80 suppliers and the Voroshilovgradskaya GRES has 95. With such a large number of suppliers, the quality characteristics of the fuel that is delivered fluctuates within very broad limits. In the absence of special blending units at the electric power plant, this makes stabilization of the fuel conditions in the fire boxes of the boiler units extremely difficult and results in a reduction in the reliability and efficiency of the power-generating units. Under the conditions of a regional fuel and energy complex this shortcoming disappears automatically, since the establishment of direct, long-term economic relationships is one of the conditions for affiliation.

The development of railway transport has become a bottleneck in recent years. Freight turnover is increasing rapidly, but the length of the main transport lines is increasing more slowly. In the Donetsk economic region, the reserves for increasing the traffic capacity at the railway terminals and on the most heavily used sections of the tracks have been practically exhausted. The main direction for the solution of the problem is the laying of second--and in some cases, third--tracks. Along with this, it is necessary to keep in mind the fact that right now an ever greater part of the oil and oil products are being transported by main pipelines. It is now also possible to transform coal into slurry of a certain consistency and move it through a hydraulic transport system, which is of great economic importance. According to data from the MPS [Ministry of Railways] and the All-Union Scientific Research Institute of Railway Transportation, about 75 million tons of coal is hauled short distances over the Donetsk Railway every year. Cars are in useful movement only 2-3 hours per day and because of the large number of transportation operations at the stations of origin and destination, they are held up for 3-5 days[1]. It is a well-known fact that short hauls on railroads on a railway are the most uneconomical. The creation of a hydraulic transport system would make it possible to avoid these delays and, at the same time, relieve the main rail lines of unprofitable cargoes and release a considerable part of the rolling stock.

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[1] PRAVDA, 31 March 1980; SOTSIALISTICHESKAYA INDUSTRIYA, 26 June 1981.

Experience in the operation of pipelines to transport liquid products shows that in this case transportation costs are reduced by a factor of two or three. The movement of coal in the form of slurry is also more economical than moving it by rail. Techniques for evaluating the comparative economic effectiveness of moving coal by different forms of transport, but it is possible to say with confidence that there will be a positive effect from the use of hydraulic pipeline systems, which is indicated by the operation of an experimental coal pipeline for the delivery of fuel to the Belovskaya TETs in the Kuzbass. This is especially important under the conditions present in the Donetsk economic region, where increased transportation volume is related to the construction of new tracks and the intensification of station development and spur track operations. The use of continuous--in this case hydraulic--transport for short hauls of coal fuel is becoming particularly urgent because of the strained balance of labor resources. According to the same data, the introduction of only two or three hydraulic transport pipelines with a productivity level of 250-300 tons per hour will make it possible to release several thousand people who are engaged in handling and delivering freight over short distances.

For the branch principle of production organization, the construction and operation of hydraulic complexes poses a number of questions of organizational order and economic interrelationships, the solution of which involves known difficulties. Primarily, this concerns the allocation of coal pipeline construction and operating costs to one branch or another, as well as a complex of questions concerning the operation of hydraulic pipeline systems. The differences of opinion that have arisen in connection with this concern branch profits and ignore the national economic essentials and the feasibility of this type of transportation. There are grounds for asserting that under conditions of cooperation, the presence of such an element in the production infrastructure will be of considerable assistance in improving the economic indicators of a fuel and energy complex.

One of the basic tasks of economics at this time should be the development of the methodological principles for the formation and operation of regional fuel and energy complexes. In connection with this, the following methodological points should be taken into consideration:
the establishment of long-term, stable, horizontal production relationships among all the units in the complex;
the insuring of dynamic development of enterprises on the basis of optimum specialization and cooperation in the output of the final product;
the use of production relationships to insure the unity of the economic interests of the fuel-producing and fuel-consuming branches;
the creation of the most favorable conditions for the maximum utilization of the combustible mass contained in the extracted coal.

Economic relationships between enterprises in the complex can be implemented by means of economic contracts that specify the amount of fuel to be delivered, its quality characteristics and the allowable deviations from the optimum values, as well as the delivery times and the material responsibility of the parties involved for violations of the contractual conditions. Thus, the economic individuality belonging to certain units of the national economy and

the economic independence characteristic of any public production subunit are preserved within the framework of the existing management system. It should be stressed that the combination of mines, an enriching mill and a heat and electric power plant into a regional fuel and energy complex has as its goal the improvement of the organization of industrial production in an economic region on the basis of a common final goal and facilitates the further development of economic contractual arrangements and the more nearly complete utilization of economic accountability.

The nature of the interrelationships among the enterprises in a complex is manifested in the joint utilization of fuel resources, the extraction, processing and use of which is, as a rule, enclosed within the framework of a production association. For this purpose, the enterprises' production capacities are balanced in order to insure the quantitative indicators for the output of the final product. It is possible to transfer part of the fuel to other electric power plants if, for example, there are changes in load dispatch schedules or an emergency shutdown of the power-producing units. Basically, however, it is assumed that the fuel that is produced will be consumed inside the complex itself.

The structure and nature of a regional fuel and energy complex is affected by the presence of two types of production and economic interrelationships: vertical and horizontal. Vertical interrelationships are branch ties that determine the general technical and technological development of subordinate enterprises in accordance with a unified policy for improving production processes and carrying out the tasks with which the branch is faced. Horizontal relationships are the ties within a complex that are aimed at the goal of obtaining a certain production result in the most efficient and economical manner. The presence of these two types of interrelationships and, consequently, of two management forms supplement each other and, in the final account, assist in improving the efficiency of public production.

When making the final selection of the form of organization of a regional fuel and energy complex, the solution of the following problems should be insured:
a rational combination of the positive aspects of branch and territorial management;
assurance of the most efficient and nearly complete utilization of coal resources;
determination of the common final goal and ways of achieving it;
assurance of economic contractual relationships and the economic interest of all production units in the final results;
the creation of conditions for reducing environmental pollution.

In order to solve the operational problems that arise during the operation of a fuel and energy complex, it is possible to create a special agency that is a council of enterprise directors that coordinates its activities with the existing forms of management of the national economy. The functions of the directors' council should include, in particular, a system for controlling fuel quality that provides for establishing the optimum level of coal quality at all stages of its production. The quality level (ash, sulfur and volatile substance content and combustion heat) should minimize the cost per unit of final output from the viewpoint of the entire complex.

The territorial-group form of organization of fuel production and consumption expands considerably the possibilities for the more nearly complete extraction of fuel and combustible mass during enrichment, the reduction of outlays for the partial improvement of quality in the intermediate stages, the utilization of thermal energy to dry the fuel and so on. Therefore, it is possible to say that the management elements of a regional fuel and energy complex do not duplicate or replace branch management elements, but supplement and improve them.

The system of economic methods for managing a regional complex also includes such problems as the organization of financial and economic relations between enterprises, relations with banks, and the creation of an accounting system. Here it is very important to select and use properly those cost indicators that would correspond completely to the actual labor costs and eliminate the possibility of obtaining a local advantage to the detriment of the industrial complex's overall interests. In this regard it is advisable to use a system of specially developed accounting prices instead of wholesale price list prices (within the framework of a give complex).

The basic purpose of accounting prices under the conditions of a regional fuel and energy complex is to equalize the profitability of enterprises from different branches of industry that have extremely different production costs. The accounting prices are used to sell the complex's final product according to existing zonal rates, to pay a mine for coal delivered to an enriching mill, and to pay for concentrate delivered to an electric power plant. What is basic in the operating mechanism of accounting prices is the provision of normal economic accountability conditions for the production activities of all the enterprises in such an association. In this they differ radically from intrabranch accounting prices, the purpose of which is to redistribute profits among enterprises that have different individual cost levels.

The realization of the advantages of a regional fuel and energy complex as the most progressive form of territorial production organization will depend to a great extent on the degree of perfection and objectivity in accounting for each production element's proportional contribution to the final result and on the material stimulation methods that are used. These problems, which relate to economic management methods, have not yet been worked out sufficiently. The goal is to create an economic management mechanism that would give the collectives of enterprises in linked branches an interest in achieving the best overall results.

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